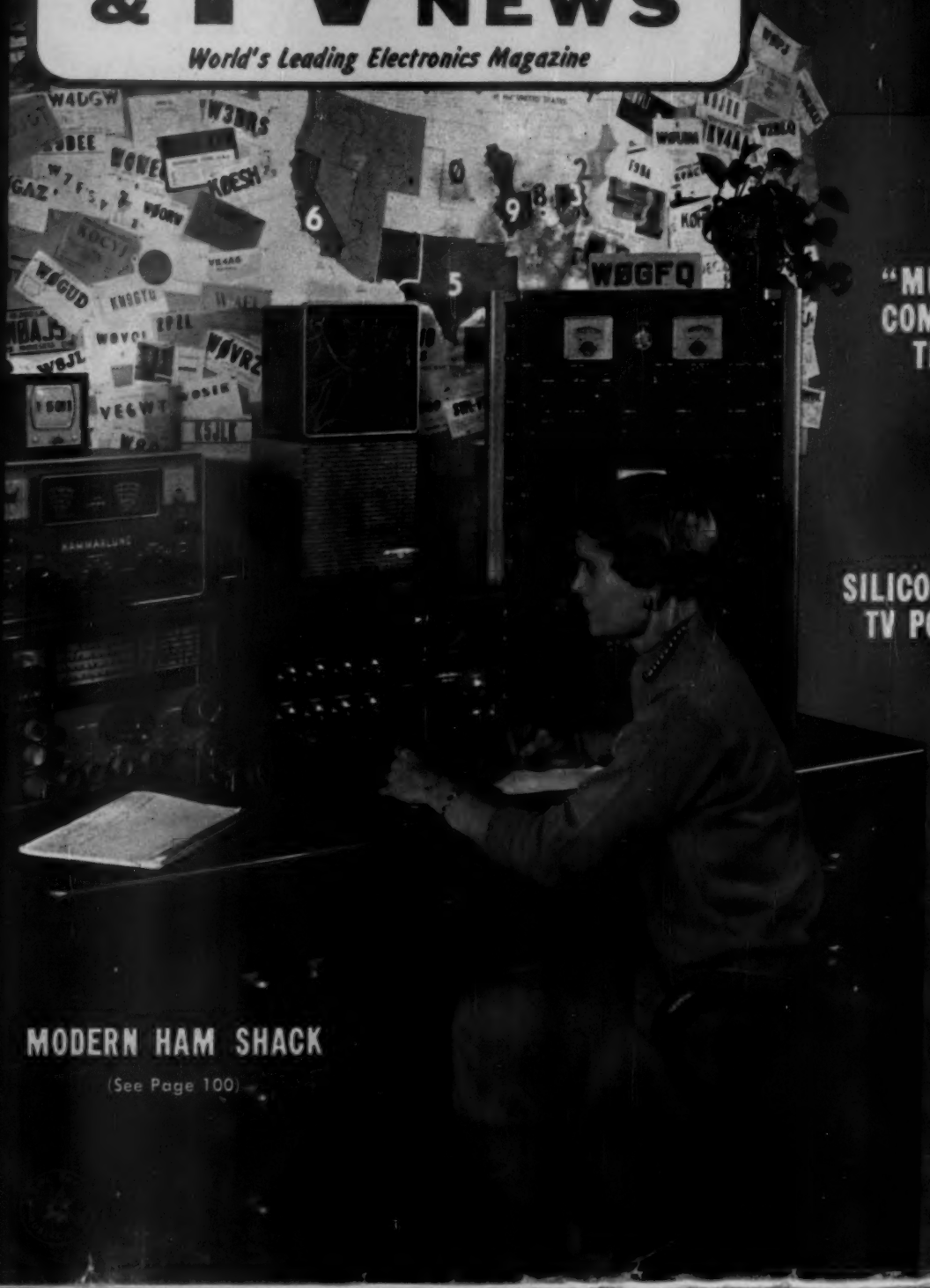
RADIO & TV NEWS

World's Leading Electronics Magazine

FEBRUARY
1958



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(See Page 100)

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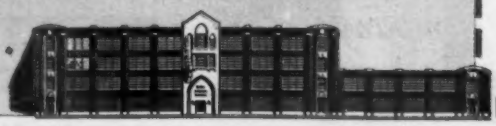

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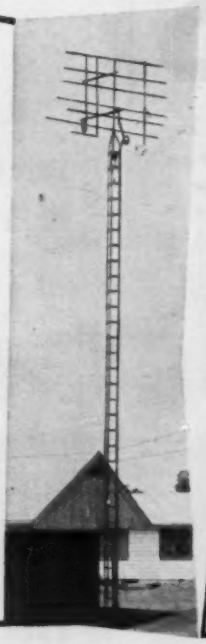

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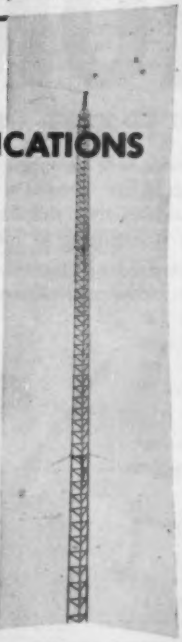

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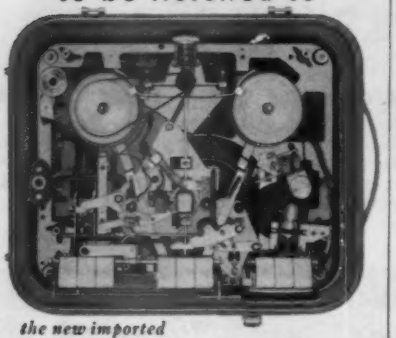

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For the RECORD

ROLE OF THE SERVICE ASSOCIATION

WHAT IS a service association? Ask all the associations in this country that question and you will wind up with an amazing diversity of answers. With differing views as to function, it is not so surprising that the service industry has not been able to come up with a universally acceptable national organization—urgent as the need may be for such an entity on those occasions when the industry must speak with a single voice—despite the unremitting efforts of many determined people.

If you survey the by-laws, the activities, and the nature of the membership of this country's service associations, you end by scratching your head. Some are scarcely more than social clubs, in which the boys get together to talk shop with others of like interest. Some are mainly concerned with the technical end of their business, admitting to membership all who service sets, regardless of their position, interested in improving their know-how with lectures on color TV or clinics on trouble-shooting horizontal-output circuits. Others may be businessmen's organizations, restricting membership to shop owners, rather than to technicians, and devoting their time to investigating overhead, stocking of parts, group insurance benefits, and the like. Some lean toward the broader issues, such as licensing, captive service, improving consumer relations, and business ethics. Still others have tried to work as buying cooperatives to get their members a break on large purchases of components.

Many associations have functioned in some or all of the directions already noted, and have also launched into others not even mentioned here. Yet, of all the ways in which a service association may operate, we have not yet encountered a single one that we would call foolish or useless. Nevertheless, this great diversification, though necessary, has been an appreciable factor in holding back unity for the entire service industry.

We know of no quick and easy solution to the problem, but we have long felt that there has never been sufficient basis for a really good perspective on the matter. Who can point out with any certainty which of the many interest trends already cited are the predominant ones—the ones that involve more service associations than others and on which there is basically little conflict in viewpoint? It has been understandably difficult for service associations to make the reliable, comparative appraisals of each other that would be needed in order to obtain such a perspective.

With your assistance, if you are the member of an association, we can satisfy our own curiosity. At the same time, we believe the project we hope to undertake will also help you. Would you like to tell the story of your association in RADIO & TV NEWS, where others may read about it? Would you like to learn what others are doing? If you would, let's get to work. We'll bring your story to the largest possible audience in the industry.

We know it isn't easy to sit down cold and get the story out. We know that, the more you want to say, the more forbidding becomes the task. Accordingly, we've put together a list of questions that should get you started. It doesn't cover everything because it would be impossible for us to do that, but it should at least get you warmed up. We're hoping that you'll tell us more than we are asking for. If you want to help us—and yourselves—in this effort, just send in the coupon on this page on behalf of your association. Our questionnaire will be sent out soon thereafter. Right now, speculation on the possible useful results of this endeavor is decidedly premature. However, rest assured that you will be kept informed of developments in these pages. . . . . W. S.

Service Editor
RADIO & TV NEWS
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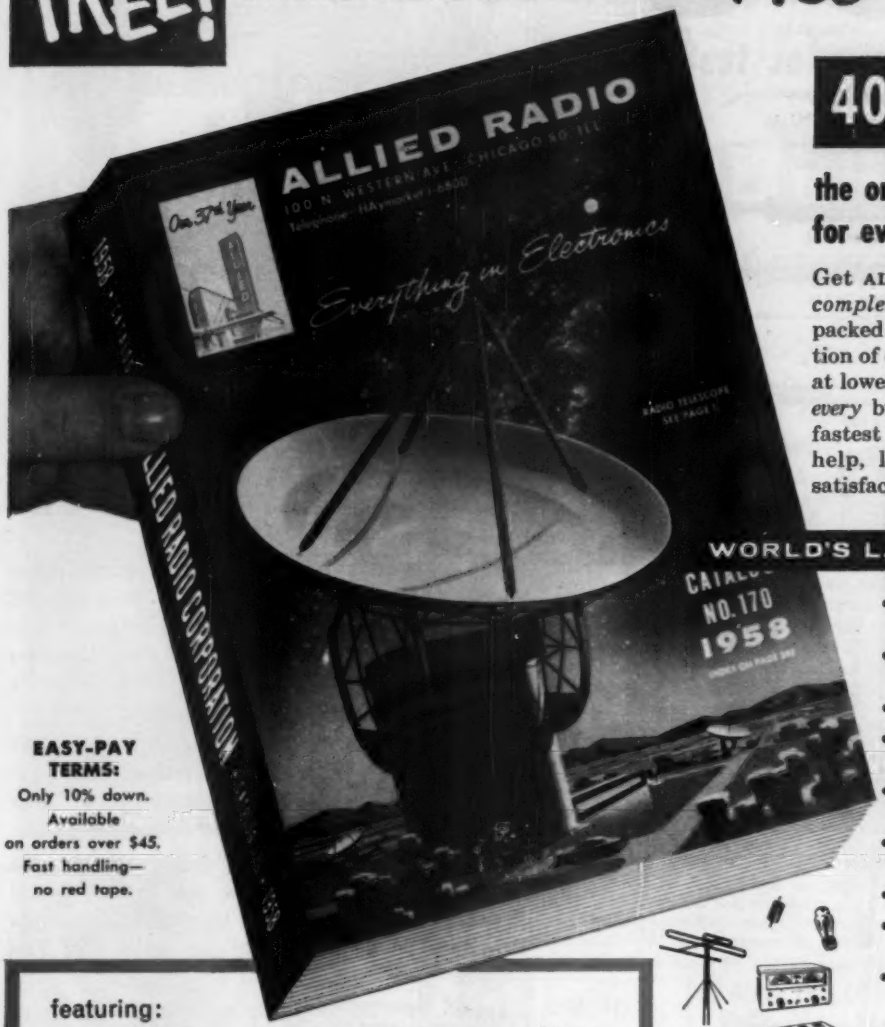

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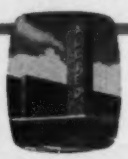

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World's Largest Electronic Supply House

send for the leading electronic supply guide **FREE!**

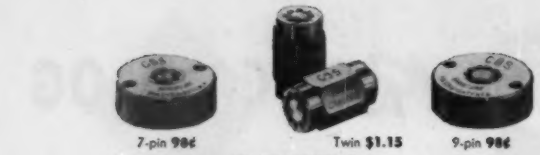
ALLIED RADIO CORP., Dept. 1-B8
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 404-Page 1958 ALLIED Catalog

*Name*_____

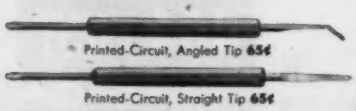
*Address*_____

*City*_____ *Zone*____ *State*_____



7-pin 98¢ Twin $1.15 9-pin 98¢

PIN STRAIGHTENERS



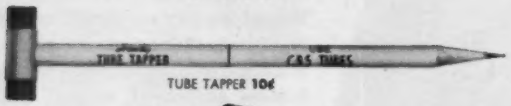
Printed-Circuit, Angled Tip 65¢

Printed-Circuit, Straight Tip 65¢

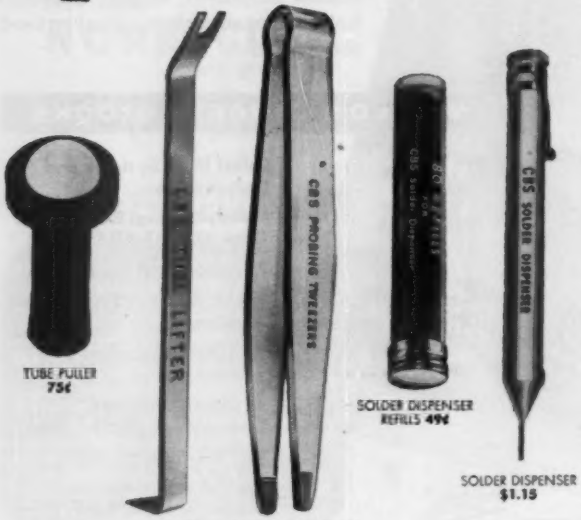
Standard, Straight Tip 65¢

Standard, Angled Tip 65¢

SOLDERING AIDS



TUBE TAPPER 10¢



TUBE PULLER 75¢

TUBE LIFTER 30¢

PROBING TWEEZERS 35¢

SOLDER DISPENSER REFILLS 49¢

SOLDER DISPENSER $1.15

PICK-UP STICK 10¢

4-WAY TOOL $1.15

7-pin min. $1.65 8-pin octal $1.55 9-pin min. $1.85

TEST ADAPTERS

These tools can make your work easier

by SERVICEMEN A CBS TOOL for SERVICEMEN

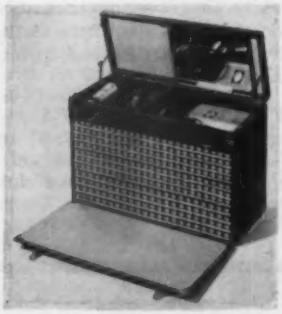
Are you using all eighteen of these tools? Designed by and for the electronic service-dealer, each can save you energy, money . . . and time.

And as you well know, a service-dealer has two major things to sell: his time and know-how. Because CBS tools save precious time, it is not surprising that over 2.5 million have been sold. Service-dealers, engineers and technicians use them habitually. The Soldering Aid, for example, has become a standard.

Many of the tools grew out of a CBS contest. All are time-tested, painstakingly developed and manufactured to give you helpful, foolproof tools. Their quality is tops, yet they are priced most economically.

Order the tools you still need from your CBS Tube distributor — particularly the new Printed-Circuit Soldering Aids. Ask to see the bigger yet handier new Tube-and-Tool Caddy. Or write today for CBS Tool Catalog, PA-6.

Let *all* the CBS tools help make *your* work easier, faster, more profitable.

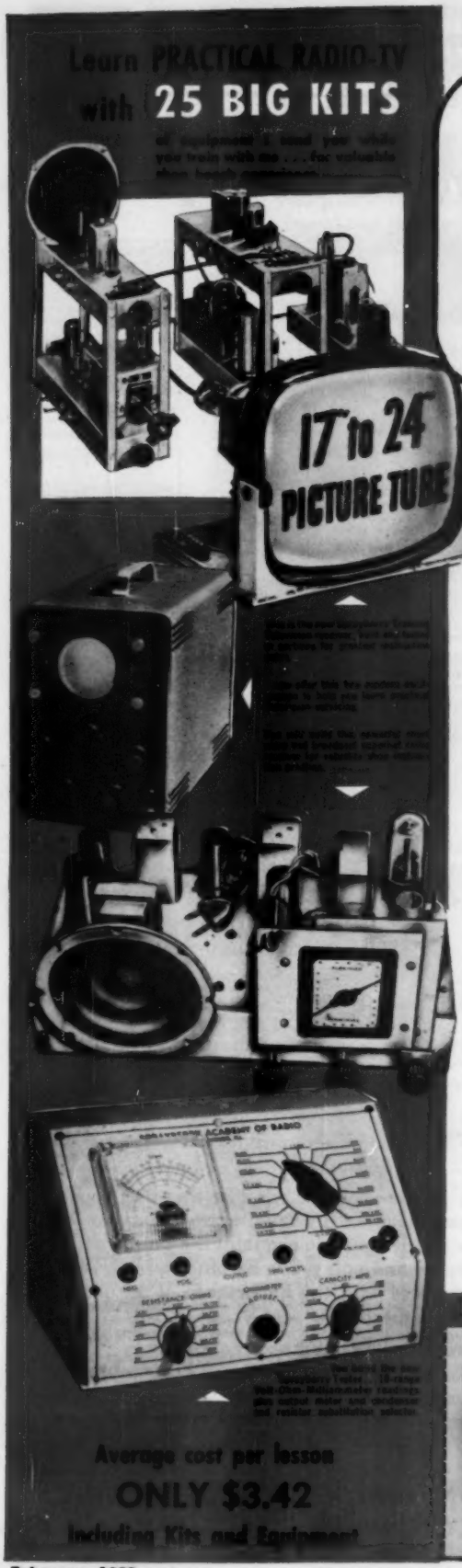


NEW TUBE-AND-TOOL CADDY $18.80

ELECTRON TUBES CBS SEMICONDUCTORS

CBS-HYTRON, Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

For the best in entertainment tune to CBS



Clip and Mail the Coupon Below—Now!

Train in Spare Hours at Home for the Best Jobs and Big Pay in

Radio-Television

—my new, faster way!

Frank L. Sprayberry
Educational Director

Want Proof? Send for my big FREE CATALOG and Sample Lesson. Let the facts speak for themselves!

Why wait—get into Radio-Television fast! I will train you in as little as 10 months to step into the top paying Radio-Television field as a much-needed Service Technician! You will train entirely at home in your spare time . . . which means you can train as fast or as slowly as you like. You have a choice of THREE Sprayberry Training Plans . . . one *exactly* suited to your needs. My easier-than-ever payment terms make it possible for you to get set for the good jobs in Radio-Television without the slightest strain on your budget! Get the true facts . . . just mail the coupon for my big new 56 page fact-filled catalog plus actual sample lesson—both FREE.

REALLY PRACTICAL TRAINING—NO PREVIOUS EXPERIENCE NEEDED

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My graduates are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

MAIL THE COUPON—See what's ahead in Radio-TV . . . No Salesman Will Call On You!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item in my training. With the facts in your hands, you will be able to decide. No salesman will call on you. The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO-TELEVISION

1512 Jarvis Avenue, Dept. 25-D, Chicago 26, Illinois

Mail This Coupon For Free Facts and Sample Lesson

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
Dept. 25-D, 1512 Jarvis Avenue, Chicago 26, Ill.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman *will call* upon me. Include New Catalog and Sample Lesson FREE.

Name_____ Age____

Address_____

City_____ Zone____ State____

RCA talks picture tubes to your customers ...presells 'em for you!

Some Important "Dos" and "Don'ts"
For Every TV Set Owner
don't
Don't wait until the all-important Picture Tube "goes" completely, before replacing it.
The Picture Tube is the heart of your set. A poor or outworn tube can spoil your TV pleasure. A reputable brand tube, with a trade-mark you know, can often make an older TV even better than new.
Don't accept "just as good".
Don't buy on "price" alone.
Don't forget to ask the TV service technician for your warranty card—12 months is virtually standard among name manufacturers today. And don't forget—a warranty is only as good as the company behind it.
do
Do specify an RCA Silverama Picture Tube for replacement.
RCA makes an RCA Silverama Replacement Picture Tube for virtually every make of set. It's the very same tube used in many of the new 1958 sets. It incorporates every great advance in tube making. It costs no more than other top-quality tubes. And, RCA backs up every Silverama with a full year's warranty.
Super Aluminized
RCA
Daylight Clear
RCA Silverama
PICTURE TUBES
RCA Electron Tube Division, Harrison, N. J.
TV GUIDE

Frequent, straight-from-the-shoulder ads like this will appear in TV Guide...reaching 5,300,000 TV families coast to coast during 1958. The ads are designed to acquaint the public with facts about picture tubes and will prove helpful in impressing your customers with the importance of asking for top-quality, brand name tubes.

These ads will also continue to build acceptance for Silverama Picture Tubes—tubes that are noted for trouble-free performance and customer satisfaction. See your RCA Tube Distributor for your copy of the newly revised RCA Silverama Picture Tube Replacement Chart.

RADIO CORPORATION OF AMERICA
Electron Tube Division — *Harrison, N. J.*

FREE... ANY 3

of these superb High-Fidelity

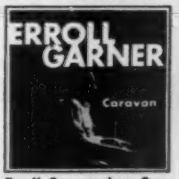
12" COLUMBIA LP RECORDS

If you join the Columbia LP Record Club now—and agree to purchase 4 selections during the coming 12 months

Two delightful and romantic ballet scores by Offenbach and Chopin

Definitive performances of three best-loved Beethoven sonatas

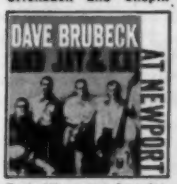
Johnny Mathis sings 12 favorites — Day In Day Out, Old Black Magic, etc.



Erroll Garner plays Caravan, No Greater Love, Memories of You, etc.

Tenderly, Deep Purple, Soon, Laura, September In The Rain, 7 others

Complete score! I Could Have Danced All Night, The Rain In Spain, etc.



7 exciting new jazz improvisations by two great modern combos

Duchin plays The Man I Love, April Showers, Am I Blue?, Brazil—11 more

Suave arrangements of Embraceable You, Somebody Loves Me—12 more

The Moon of Manakoora, Lotus Land, Poinciana, Jamaican Rhumba, etc.

Armstrong and his All-Stars. 10 numbers from triumphant tour abroad

Stunning hi-fi performances of the "Firebird" and "Romeo and Juliet"

Doris Day sings The Song Is You, But Not For Me, Autumn Leaves—9 more

Emperor Waltz, Blue Danube, Vienna Life, Gypsy Baron Overture—2 more

12 Sinatra favorites — Mad About You, Love Me, Nevertheless, etc.

A romantic musical tour —Ormandy and The Philadelphia Orchestra

Rodgers & Hammerstein's fabulous hit, with Nelson Eddy as Curly

3 Gershwin works—Concerto in F, Rhapsody in Blue, American in Paris

12 inimitable Elgart arrangements — ideal for listening or dancing

THE GREAT MELODIES OF TCHAIKOVSKY
ROMANTIC MELODIES FROM:
ROMEO AND JULIET, SLEEPING BEAUTY,
5TH SYMPHONY, NUTCRACKER SUITE,
QUARTET IN D, SYMPHONY PATHETIQUE,
MARCHE SLAV, SERENADE FOR STRINGS

Eight of the best-loved melodies of all time — magnificently performed

America's favorite quartet sings Love Walked In and 11 others

Benny Goodman and his Original Orchestra, Trio and Quartet. 11 numbers

6 works: Symphony No. 3, Academic Festival Overture, 4 Hungarian Dances

The complete score of Lehar's operetta—Villa, Maxim's, Women, etc.

☆ **You receive, at once, any 3 of these records—FREE. One is your gift for joining, and the other two are your Bonus records "in advance"**

☆ **After you have purchased only four records, you receive a 12" Columbia LP Bonus record of your choice FREE for every two additional selections you purchase from the Club**

☆ **You enroll in any one of the four Club Divisions: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies**

☆ **Every month you receive, FREE, a new issue of the Columbia LP Record Club Magazine — which describes all forthcoming selections**

☆ **You may accept or reject the selection for your Division, take records from other Divisions or take NO records in any particular month**

☆ **Your only membership obligation is to buy four selections from the more than 100 to be offered in the coming 12 months. You may cancel membership any time thereafter**

☆ **The records you want are mailed and billed to you at only $3.98 (original cast Musical Shows somewhat higher), plus small mailing charge**

☆ **You must be delighted with membership or you may cancel it by returning the free records within 10 days**

COLUMBIA LP RECORD CLUB
TERRE HAUTE, INDIANA

FREE — ANY 3 — MAIL ENTIRE COUPON NOW!

COLUMBIA LP RECORD CLUB, Dept. 597
TERRE HAUTE, INDIANA

Please send me as my **FREE** gift the 3 records whose numbers I have circled at the right — and enroll me in the following Division of the Club:

(check one box only)

☐ **Classical** ☐ **Listening and Dancing** ☐ **Jazz**

☐ **Broadway, Movies, Television and Musical Comedies**

I agree to purchase four selections from the more than 100 to be offered during the coming 12 months . . . at regular list price, plus small mailing charge. For every two *additional* selections I accept, I am to receive a 12" Columbia LP Bonus record of my choice **FREE**.

Name.....
(Please Print)

Address.....

City.....Zone.....State.....

CANADA: Prices slightly higher, address 11-13 Soho St., Toronto 2B

If you wish to have this membership credited to an established Columbia Records dealer, authorized to accept subscriptions, please fill in the following information:

Dealer's Name.....

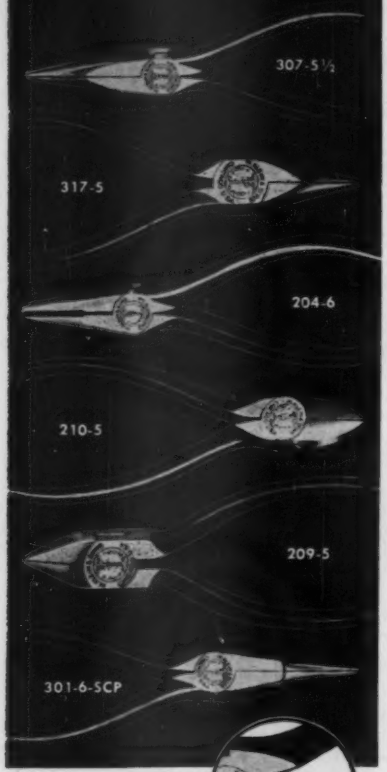
Dealer's Address.....85-2

© Columbia Records Sales Corp., 1958

CIRCLE 3 NUMBERS BELOW:

1. Eddy Duchin Story
2. Beethoven: 3 piano sonatas
3. Erroll Garner ("Caravan")
4. Gaîté Parisienne; Les Sylphides
5. Easy To Remember—Luboff Choir
6. My Fair Lady—Orig. Broadway Cast
7. Brubeck and Jay & Kai
8. Gershwin Hits—Percy Faith
9. Sinatra—Adventures of the Heart
10. Ambassador Satch
11. Firebird; Romeo and Juliet
12. Day By Day—Doris Day
13. Johann Strauss—Waltzes
14. Lure of the Tropics—Kostelanetz
15. Ports Of Call
16. Oklahoma!
17. Levant Plays Gershwin
18. The Elgart Touch
19. The Great Melodies of Tchaikovsky
20. Suddenly It's the Hi-Lo's
21. King of Swing—Benny Goodman
22. Brahms: Symphony No. 3
23. The Merry Widow
24. Wonderful, Wonderful—Mathis PE-1

KLEINS
for the
ELECTRONICS
INDUSTRY



All pliers shown may be had with coil spring to hold jaws in open position. Spring guaranteed for the life of the plier.

Light in the hand . . . comfortable to use . . . points carefully matched . . . knives hand honed—all these features are yours with genuine Klein Pliers.

100 years of engineering skill and manufacturing experience are behind every pair of Kleins you buy.

You will be amazed at how much better a job you can do . . . how much faster you can do it . . . when the pliers you use are Kleins.

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard Electric Corp., New York

100 years of service to linemen, electricians and industry is back of this new PocketTool Guide No. 100. A copy will be sent to you on request without obligation.

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.

Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TV NEWS
WASHINGTON EDITOR

A NEW SPACEFLIGHT project, the *Pied Piper*, calling for a massive and elaborately equipped satellite to orbit between 800 and 1100 miles from earth, using television scanners and facilities for transmission to ground stations, is now underway.

Designated as project WS-117L and assigned to *Lockheed* which has tagged the program as *ARS* for Advanced Reconnaissance Satellite, the first satellite will be an unmanned object, but subsequent models with manning in mind have been blueprinted.

The original idea for the satellite was initiated by the USAF three years ago. The initial budget for the program, set in 1956, was $4-million; it has been increased to $12-million. The target date for the unmanned satellite is during 1958 and 1960 has been set as the date the Air Force hopes it can get a manned object launched.

SUBLIMINAL PERCEPTION *via* TV, a new advertising technique under investigation by scores of advertising and engineering experts, which has been described as . . . "the faculty of absorbing fleeting visual information without being consciously aware of it" . . . is now up for an official study in Washington by the Commission.

For further information see "Subliminal Ads Tried on TV" on page 143.

THE EIGHTEEN MONITORING stations of the FCC, the first Federal agency to track the original *Sputnik* to any extent, took over 3000 direction finder bearings and over 250 fixes on the first satellite. The spot checks were supplied to *Project Vanguard* of the Naval Research Laboratory and to the Bureau of Standards, as well as Stanford Research Institute.

The 18 stations which participated in the tracking operation are located in Allegan, Michigan; Grand Island, Nebraska; Kingsville, Texas; Millis, Massachusetts; Santa Ana and Livermore, California; Laurel, Maryland; Portland, Oregon; Powder Springs, Georgia; Lanikai, Hawaii; Searsport, Maine; Spokane, Washington; Douglas, Arizona; Fort Lauderdale, Florida; Ambrose, Texas; Chillicothe, Ohio, and Anchorage and Fairbanks, Alaska.

The positioning operation is a complicated affair involving direction finding (getting bearings on the direction from whence the satellite radio signals come) and then fixing—by the same means used in navigation—the exact spot on the western hemisphere over which the small object is passing.

Because of the terrific velocity at which the satellites move (one travels at five miles a second), speed and exacting coordination are essential. The FCC monitors have to take these bearings during the brief time the satellite

NEW TELEVISION STATION GRANTS

Additional listing of new construction permits and changes that have been made in station call letters, as released by the FCC.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Oklahoma	Elk City	....	8	180-186	14.96
South Dakota	Mitchell	KORN-TV	5	76-82	23.4

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Illinois	Champaign	WCHU	33	584-590
Pennsylvania	Erie	WICU-TV (Formerly WICU)	12	204-210

* ERP = (effective radiated power, kw.)

I chose COYNE TELEVISION

RADIO-COLOR TV

home training because Coyne has been training men for good jobs OR their OWN BUSINESS for NEARLY 60 YEARS

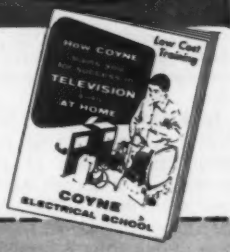
Giant opportunity field! Join the thousands Coyne Home Training is preparing for a successful future in TV—open the door to better pay jobs, *or* your own business! COYNE—a leading residential, practical school—oldest of its kind—established 1899—*is the institution behind this training.*

Here is **MODERN—QUALITY TELEVISION** Home Training designed to meet the rigid standards that have made Coyne famous. You get personal supervision of Coyne Staff who know TV and know how to teach. **Learn quickly and easily in spare time.** No previous experience or advanced education necessary.

I chose COYNE because their new method costs less than half what most others do!

SEND COUPON FOR FREE BOOK

Send coupon below for all-new fully-illustrated book and full details including **EASY PAYMENT PLAN. NO COST OR OBLIGATION—NO SALESMAN WILL CALL**



Modern, up-to-the-minute. Easy to follow, step-by-step instructions—fully illustrated with 2150 photos and diagrams. **UHF and COLOR-TV included.** So practical you can quickly earn extra money in TV-Radio Sales and Service. Not only Coyne Quality training, but costs *half* what you'd expect to pay because you pay only for training—no costly extras. Free life-time employment service.

B. W. Cooke, Jr.
President

COYNE ELECTRICAL SCHOOL Founded 1899

A TECHNICAL TRADE INSTITUTE OPERATED NOT FOR PROFIT

500 S. Paulina Dept. 28-H6 Chicago 12, Illinois

COYNE TELEVISION
HOME TRAINING DIVISION
500 S. Paulina St., Chicago 12, Ill.
Dept. 28-H6

Send FREE Book and details of your Television – Radio – Color TV Home Training offer.

*Name*_____

*Address*_____

*City*_____ *State*_____

is crossing this section of the globe.

The monitoring network of the Commission is now tracking the second satellite, in the same way it followed the first. Frequencies involved are 20,005 and 40,002 kc.

BARTLESVILLE, the guinea-pig town in Oklahoma where toll-TV is being tested, is against the plan, according to Senator William Langer.

In a survey conducted among the 8000 families in the test town by the Senator—who is a member of the Senate Judiciary anti-trust subcommittee—over 1800 said that they were not in favor of pay-TV, while only 157 said they were for the idea and 150 noted that they were against toll-television, but did like the *Telemovie* program.

Commenting on the results, the Senator said that the views confirmed his feeling that . . . "pay-as-you-see television . . . will ultimately result in poor people getting poorer programs, while those who can afford to pay will get better programs . . ."

FOR THE FIRST TIME since 1927, the International Scientific Radio Union (*URSI*—named from the initials of its French title, Union Radio Scientifique Internationale) held its 12th general assembly in this country in Boulder, Colorado, to exchange technical information, coordinate international research efforts, and recommend future projects.

Local hosts were the Boulder Laboratories of the Bureau of Standards, the University of Colorado, the High-Altitude Observatory, and the City of Boulder.

Much of the discussion on radio measurements and standards dealt with standards of time and frequency. Dr. L. Essen (National Physical Lab, Teddington, England) surveyed recent improvements in quartz-crystal oscillators and the development of atomic frequency standards such as the ammonia Maser and the cesium-beam standard.

Dr. J. A. Saxton (Radio Research Station, Sloush, England) reported on numerous developments in radio-frequency measurements during the last three years.

In a paper, prepared by the Swedish Research Institute of National Defense, propagation of 20 to 80 mc. waves over a mixed earth-water path was described. The report showed that, in general, a maximum height gain of roughly 7 decibels above that expected over a smooth earth is obtained just before reaching the top of a hill, going from land to water; and that, for fresh water, recovery of over-water field strength occurs at 25 to 30 wavelengths from the shoreline. Dr. Saxton (England) noted that, on the average, within-the-horizon field strengths fall below the smooth earth field at higher and higher frequencies, possibly because antennas intervisible over a smooth earth are not inter-

How to Pass

An FCC License can be

Get Your FCC License

We Guarantee
to train you until you receive
Your FCC License

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial FCC License with a radar endorsement. Completion of Section I only of the Master Course will prepare you for a Second Class Commercial FCC License. We guarantee to train and coach you, without any additional cost, until you receive the FCC License as indicated above. This guarantee is valid for the entire period of your enrollment agreement.

Cleveland Institute Training Results in success with commercial FCC examinations . . . easily . . . and quickly.

every month our trainees get jobs like these:

Boyd Daugherty:

"I recently secured a position as Test Engineer with Melpar, Inc. A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."

Boyd Daugherty
105 Goodwin Ct., Apt. C
Falls Church, Va.

Top Grade Employers Like These Look

Bendix Radio: "We shall look forward to receiving completed applications from your students."

Philco: "We have employed a great number of well qualified electronics personnel who were graduates of Cleveland Institute."

Westinghouse: "We would appreciate your listing our current openings in your monthly Job Opportunities."

(Commercial)

FCC License Exams

your Guarantee of Success in Electronics

in a Minimum of Time

mail coupon NOW!

here's proof . . .

Name and Address	License	Time
Walter Eggers, Pacific Grove	1st	12 weeks
Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, La Porte, Indiana	1st	28 weeks
John H. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks

James Glen:

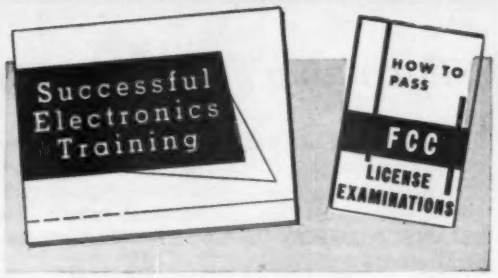
When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
Tacoma, Washington

To Cleveland Institute

Aerojet-General
American Airlines
American Telephone & Telegraph Co.
Bendix Radio
Braniff Airways
Burroughs Corp.
Capital Airlines
Continental Air Lines, Inc.
Convair
General Electric
Glenn L. Martin Co.
Goodyear Atomic Corp.
IBM
International Telephone & Telegraph Co.
Mohawk Airlines
Motorola
North American Aviation, Inc.
Northwest Airlines
Philco
RCA
Ryan Aeronautical Co.
**Plus many others*

Get Both FREE



Accredited by National Home Study Council

Cleveland Institute of Radio Electronics

Desk RN-14, 4900 Euclid Ave., Cleveland 3, Ohio

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other .....

In what kind of work are you now engaged? .....

In what branch of Electronics are you interested? .....

Name ..... Age.....

Address .....

City ..... Zone..... State.....

Special Tuition Rates to Members of Armed Forces — Desk RN-14

New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

The Turntable That Changes Records

From Collaro Ltd., world's largest manufacturer of record playing equipment—comes the most significant development in years—the exclusive new transcription-type tone arm, which transforms the conventional record changer into a TRANSCRIPTION CHANGER, with features of the finest professional equipment.

The arm is a one-piece, spring-damped, counter-balanced unit which will take any standard high-fidelity cartridge. It is free of any audio spectrum resonances.

Stylus pressure between the first and last record in a stack remains virtually constant at less than a gram of difference, compared to 4 to 8 grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level, insuring longer life for records and styli.

In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment, offering professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of Mississippi.)

ROCKBAR Corporation

FREE: Colorful new catalog, containing guide on building record library plus complete Collaro line. Write to Dept. R-014

ROCKBAR CORPORATION
MAMARONECK, N. Y.

Rockbar is the American sales representative for Collaro Ltd. and other fine companies.

visible over the actual terrain used.

In another report, Dr. R. A. Helliwell (Stanford University) revealed that man-made radio signals had, for the first time, been successfully transmitted along *whistler* paths from the northern to the southern hemisphere. (A *whistler* occurs when an electrical disturbance caused by a lightning discharge travels along the lines of magnetic force of the earth's field until it reaches the magnetically conjugate point on the earth's surface, from which it is then reflected back to the point of origin. Sometimes more than one such *echo* is produced. The characteristic drawn-out descending pitch of the whistler is a dispersion effect due to the greater velocity of the higher-frequency components in the disturbance.)

RADIO ASTRONOMY was also a featured subject at the Boulder meeting. Three principal topics were discussed: techniques of reception, antennas, and observations of the moon, planets, and comets.

Dr. W. N. Christiansen (Commonwealth Scientific and Industrial Research Organization, Australia) described an interferometer operating at 1420 megacycles and capable of producing a complete picture of the radio sun by television-wise scanning with its narrow pencil beam.

J. H. Trexler (NRL) reported on moon-echo experiments with a 220-foot parabola which show that the echoes are reflected almost entirely from a relatively small area of the moon's surface. Using moon-echo methods, B. S. Yaplee, also of NRL, said that he has measured the distance to the moon so accurately that the principal errors depend on the uncertainties in the earth's radius and the electron density between the earth and the moon.

SOME VERY RECENT advances in the design of surface-wave antennas were disclosed by J. P. Simon (France) at the *URSI* symposium. The principal novelty of the developments, it was reported, is that surface waves are launched on a structure with a modulated phase velocity. An example is the *cigar* antenna; a dielectric rod with concentric metal discs of different sizes.

A PIONEERING PROGRAM to gather basic information about instrument flying in helicopters is underway in the Washington area.

Anticipating the day when multi-engine helicopters will shuttle over all-weather routes between cities, the CAA, with a big assist from the military, is now in the midst of learning answers to basic questions which affect the whole future of such operations.

CAA pilots are carrying out the study with a big HSS-1 helicopter on loan from the Navy. The HSS-1, a

(*Continued on page* 134)

Learn TELEVISION-RADIO

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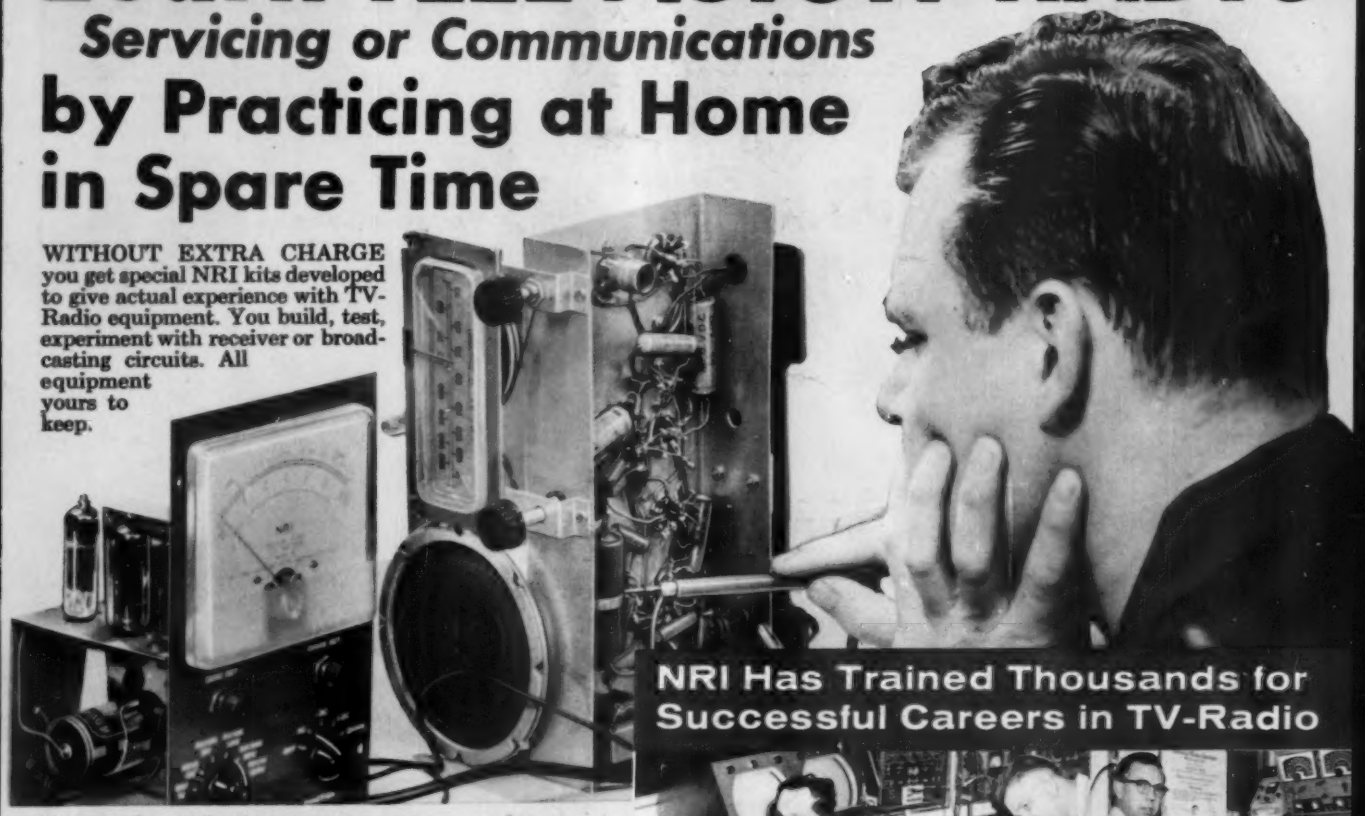

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People *look up to* and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a TV-Radio Technician. At home, and in your spare time, *you* can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere *here* in the fast growing Television-Radio field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

Increased Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Television-Radio Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. The hundreds of TV and Radio Stations on the air offer interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time TV-Radio sales and service businesses.

Act Now—See What NRI Can Do for You

NRI has devoted over 40 years to developing simplified practical training methods. You train at home. Get practical experience, learn-by-doing. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Has Trained Thousands for Successful Careers in TV-Radio

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling for the NRI Course, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"Since finishing NRI Course I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Ga.

Has Good Part Time Business
"Quite early in my training I started servicing sets. Now have completely equipped shop. My NRI training is the backbone of my progress." E. A. BREDA, Tacoma, Wash.

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YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.

YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs Be a Television-Radio Technician

Servicing Needs More Trained Men

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Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Television-Radio school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with NRI Courses. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: NATIONAL RADIO INSTITUTE, Washington 16, D. C.

NRI Graduates Do Important Work

Now Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. FAVALORO, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. CRESSEY, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA-TV." J. F. MELINE, NewYork, N Y.

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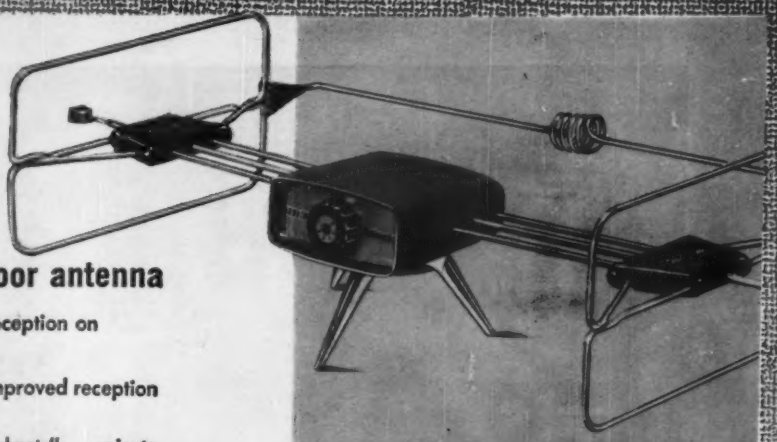
- **Metro-Dyne Electronic Tuning** reduces "ghosts"... rejects unwanted signals... filters out electrical interference on ALL CHANNELS.



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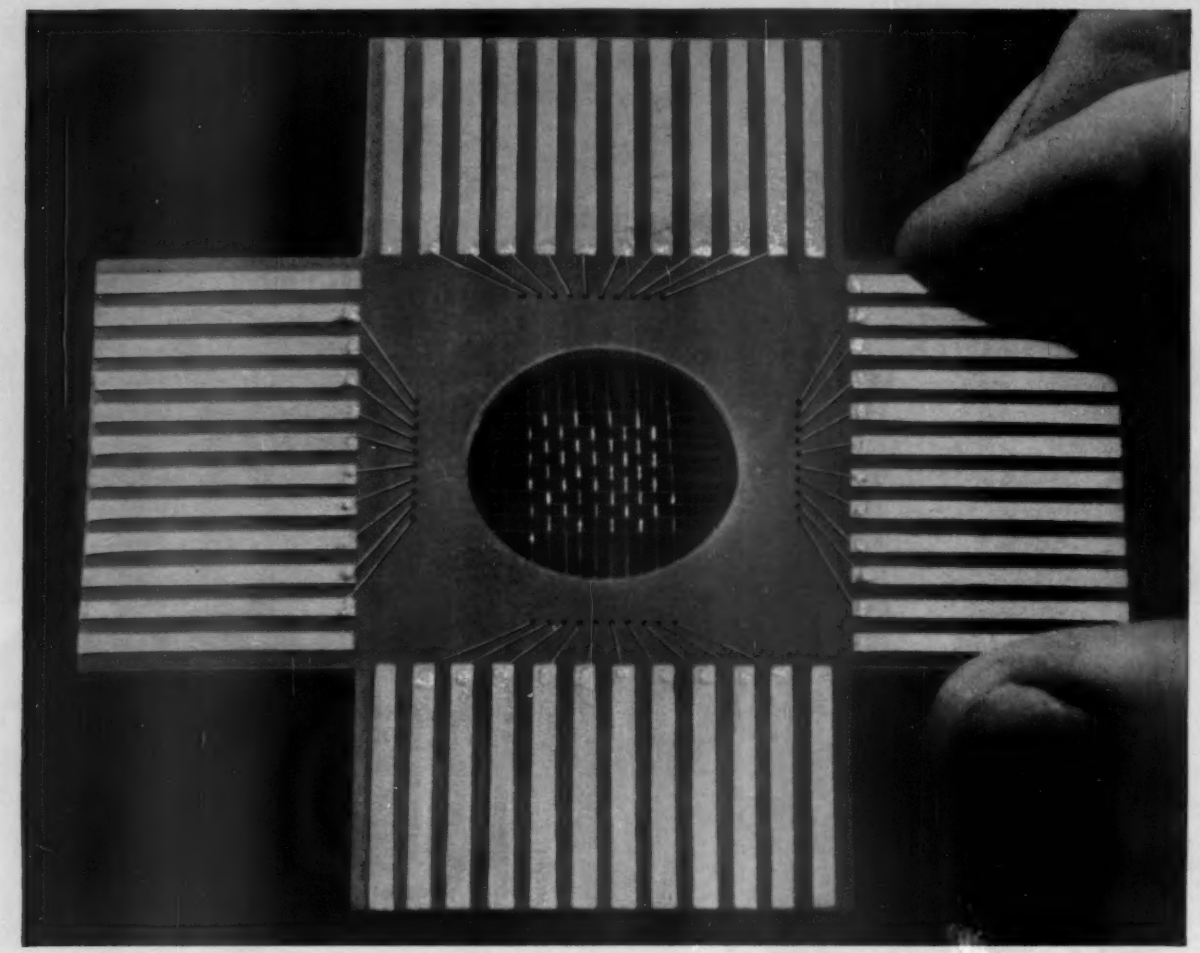

Model (simplified) illustrates basic structure of magnetic "Twistor" memory—magnetic and copper wires interwoven as in a window screen. Twisted condition of the magnetic wire shifts preferred direction of magnetization from a longitudinal to a helical path. One inch of twisted wire, thinner than a hair, can store as much information as ten ferrite rings. "Twistor" was invented at Bell Laboratories by Andrew Bobeck, M.S. in E.E. from Purdue University.

New twist in memory devices

An ingenious new kind of magnetic memory has been developed by Bell Laboratories scientists for the storage of digital information. Known as the "Twistor," it consists basically of copper wires interwoven with magnetic wires to form a grid.

"Twistor" gets its name from a characteristic of wire made of magnetic material. Torsion applied to such a wire shifts the preferred direction of magnetization from a longitudinal to a helical path. This helical magnetization has been applied to produce a magnetic storage device of unprecedented capacity for its size.

In a magnetic memory, information is stored by magnetizing a storage element. In conventional memories the storage elements consist of rings of ferrite. In the "Twistor," they consist of tiny segments of hair-thin magnetic wire. At each intersection of the grid, one such segment is capable of storing a binary digit.

The "Twistor" is simple and economical to fabricate, and its minute energy requirements are easily supplied by transistor circuits. Bell Laboratories engineers see important uses for it in future telephone systems which demand the compact storage of much information, as well as in digital computers for civilian and military applications.

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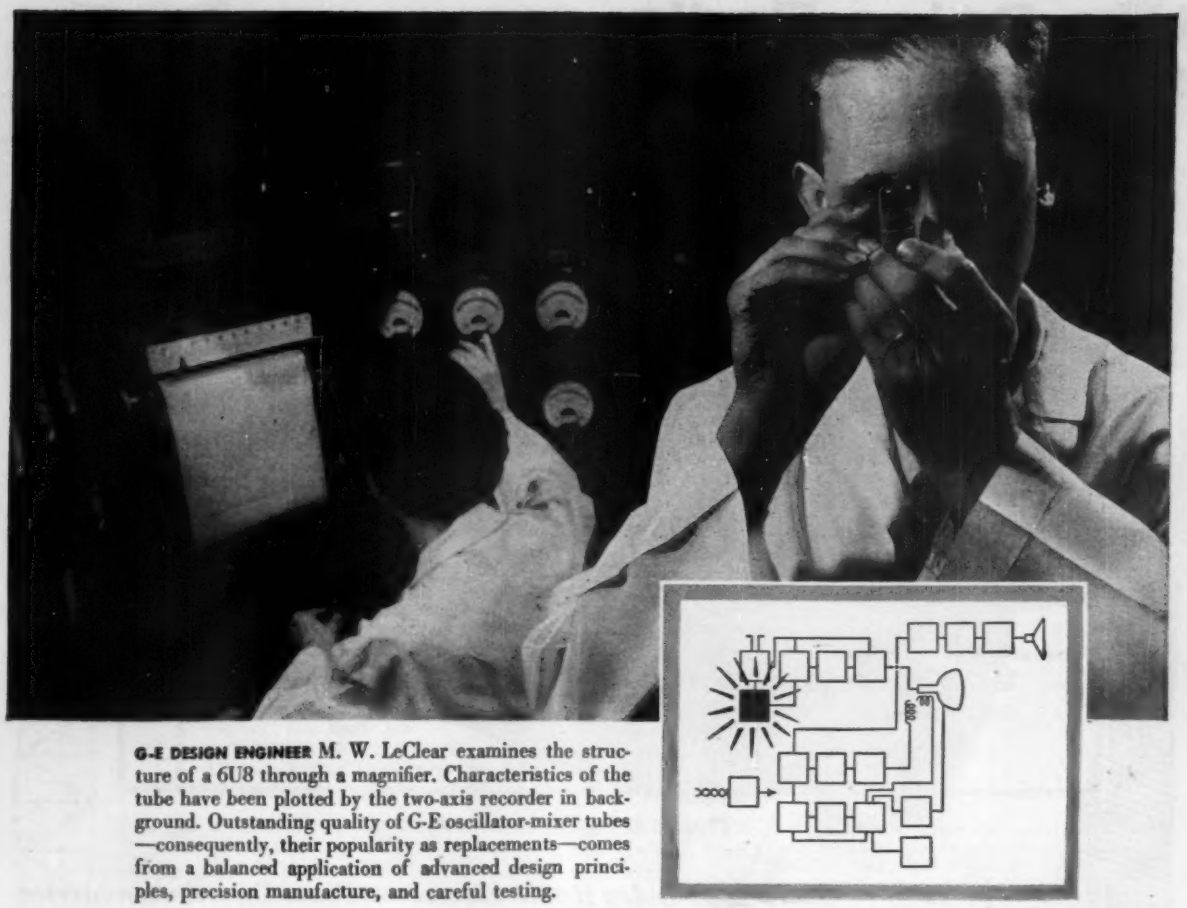

G-E DESIGN ENGINEER M. W. LeClear examines the structure of a 6U8 through a magnifier. Characteristics of the tube have been plotted by the two-axis recorder in background. Outstanding quality of G-E oscillator-mixer tubes—consequently, their popularity as replacements—comes from a balanced application of advanced design principles, precision manufacture, and careful testing.

Superior quality of G-E oscillator-mixer tubes proved by their high gain and uniform electrical characteristics!

Time is your most valuable commodity. Any replacement that conserves your working time and makes it more productive, puts extra dollars in your pocket.

The case for General Electric oscillator-mixer tubes rests on that benefit. These quality types—such as the 6U8, 6X8, 6CL8, 6CG8—have uniform tube-to-tube electrical properties. Install them as head-end replacements, and no adjustment of the coarse oscillator frequency control normally is needed.

Add the saving in call-back time that comes from first-class performance of customers' receivers! For high-gain General Electric oscillator-mixer tubes reduce noise. Their low microphonics mean minimum streaking and similar picture disturbances.

Complete redesign of the pentode section was necessary to obtain the high tube gain you require for top performance. Rigid tube structure and precision control of grid-rod and mica-aperture diameters keep down microphonics. Uniform electrical characteristics of G-E oscillator-mixer types are a product of (1) the industry's most advanced methods of manufacture to high-quality standards, (2) testing and retesting.

Install General Electric tubes for superior performance you can count on . . . every time, from every tube! Your G-E tube distributor makes fast deliveries. Phone him! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

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Use Delco Radio Service Parts!

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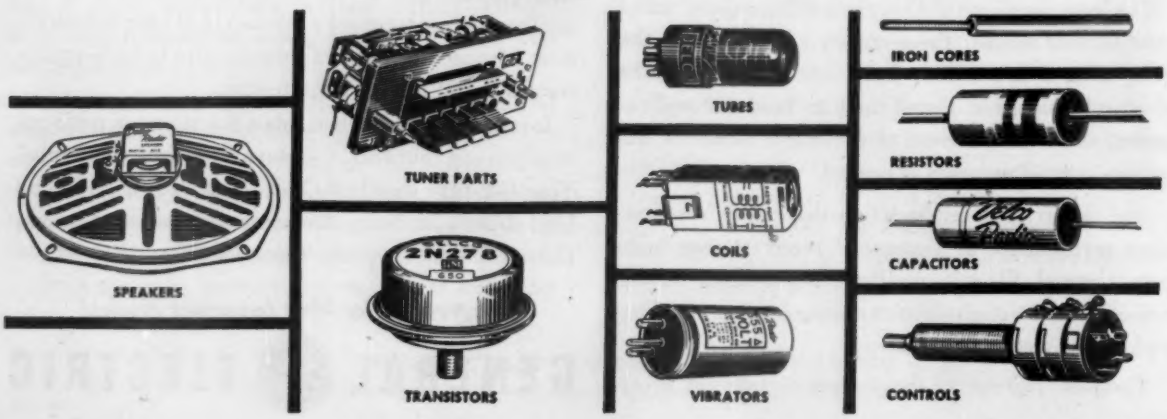
DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA



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6. AUTOMATION
7. RADAR AND MICRO WAVES
8. COMMUNICATIONS

YOU ARE NEEDED IN THE TELEVISION-ELECTRONICS-RADIO INDUSTRY! You can build a secure future for yourself if you get into Electronics NOW! Today's shortage of trained technicians creates tremendous opportunities. National Schools Shop-Method trained technicians are in constant and growing demand for high-pay jobs in Broadcasting and Communications, Electronic Research, Servicing and Repair, and many other branches.

Let National Schools, a Resident Technical School for over 50 years train you for today's unlimited opportunities in electronics! Our Shop Method trains you to be a MASTER-TECHNICIAN. Completely up to date, developed by experienced instructors and engineers, your Telerama Course will teach you all phases of the industry quickly, clearly and correctly. You can master the most modern projects, such as Color TV, printed circuits — even prepare for FCC License without taking a special course. You can handle sales, servicing, manufacturing, or make good money in your own business. SEND FOR FACTS TODAY!

EARN AS YOU LEARN. Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning.

YOU GET EVERYTHING YOU NEED — Clear, profusely illustrated lessons, shop-tested manuals, modern circuit diagrams, practical job projects — all the valuable equipment shown above — many other materials and services — consultation privilege with our qualified staff, and Graduate Employment Service. EVERYTHING YOU NEED for outstanding success in Electronics.

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If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shops, Labs and Radio-TV Studios. Here you work with latest Electronic equipment—professionally installed—finest, most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school—and part time job while you learn. Check box in coupon for full information.

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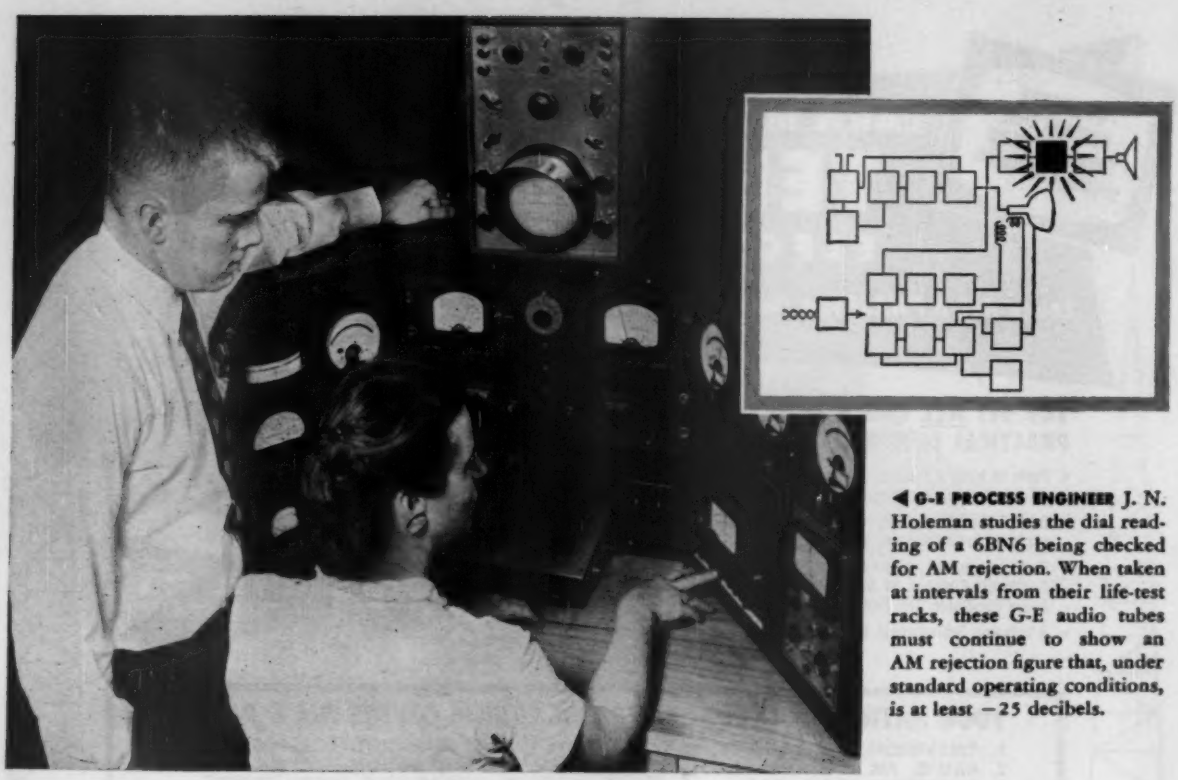

◀ **G-E PROCESS ENGINEER** J. N. Holeman studies the dial reading of a 6BN6 being checked for AM rejection. When taken at intervals from their life-test racks, these G-E audio tubes must continue to show an AM rejection figure that, under standard operating conditions, is at least −25 decibels.

Guard customers' sets from hum and sync buzz! Install G-E high-quality TV audio tubes!

Once you have adjusted the buzz control on a customer's TV set for noise-free audio, it is annoying ... and costly in working time ... to be summoned back later because the buzz has recurred.

Change in the AM-rejection characteristics of an audio tube may produce this result. In order to keep down service callbacks needed to remove buzz and hum, General Electric tests 6BN6's, 3AL5's, 5T8's, and other audio detector types under conditions which closely parallel actual operation—and over periods of time that give ample opportunity for any change in characteristics to develop.

This testing for stability of characteristics throughout tube life, supplements G-E manufacture that employs fully every modern method for building superior performance into the finished product.

A pace-setter in designing and applying audio types, General Electric brings you tubes for replacement that add real listening pleasure to customers' visual enjoyment. Install audio-tube quality you can back up ... and which will back up *your* service reputation! Phone your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

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microphonics
in a high-μ dual triode . . .

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ECC83 A PLUG-IN
REPLACEMENT FOR THE **12AX7**

MICROPHONICS:

Negligible in amplifiers requiring an input voltage of at least 50 mv for an output of 5 watts. No special precautions against microphonics necessary even though the tube is mounted in the near vicinity of a loudspeaker with 5% acoustical efficiency.

HUM AND NOISE LEVEL:

Better than —60 db relative to 50 mv when the grid circuit impedance is no greater than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is by-passed by a capacitor of at least 100 mfd.

OTHER **Amperex TUBES** FOR HIGH-FIDELITY AUDIO APPLICATIONS:

EL84/6BQ5	9-pin power pentode; 17 W PP
6CA7/EL34	High-power pentode; 100 W PP
EF86/6267	Low-noise high-μ pentode
ECC81/12AT7	Low-noise medium-μ dual triode
ECC82/12AU7	Low-noise low-μ dual triode
GZ34	Cathode-type rectifier; 250 ma.
EZ80/6V4	9-pin rectifier; cathode; 90 ma.
EZ81/6CA4	9-pin rectifier; cathode; 150 ma.

At All Leading Electronic Parts Distributors

Amperex
ELECTRONIC CORP.
230 Duffy Ave., Hicksville, Long Island, N.Y.

Within the Industry

ROY A. LONG, research engineer in *Stanford Research Institute's* engineering research division, has been elected a Fellow in the Audio Engineering Society.

Mr. Long has been with the Institute since 1949. The Fellowship was awarded to him in recognition of his active participation and many contributions to audio engineering.

Formerly chairman of the San Francisco Chapter of the Society, Mr. Long is also a member of the Institute of Radio Engineers, the Acoustical Society of America, and the Research Society of America.

• • •

JOSEPH S. RAMER has taken over the duties as engineering advisor for the *Heath Company* and will work closely with the company's engineers in developing new do-it-yourself kits for the firm's already extensive line. He will report directly to E. C. Fiebich, director of engineering of the company.

Prior to joining the firm, Mr. Ramer was engaged in electronic development work for the National Bureau of Standards and later headed the Fuze Department, U. S. Naval Ordnance Laboratory, Corona, Calif. where he supervised classified electronic work for the government. He has been in the electronics field for over 20 years, 15 of them with the U. S. government.

• • •

REEVES SOUNDCRAFT CORP. is building an ultra-modern robot tape plant in Danbury, Conn., which is scheduled for completion by mid-year. The plant and its facilities will represent an investment of over 1 million dollars . . . **CANNON ELECTRIC COMPANY'S** Santa Ana California Division is building a new 106,000 square foot plant which is scheduled to be in production soon. Located on a 30 acre site, the plant will eventually employ 1500 persons . . . **GENERAL TRANSISTOR CORPORATION** has leased an additional 16,000 square foot building at 87-11 130th St., Richmond Hill, N. Y. for the manufacture of semiconductor products . . . **SOLA ELECTRIC CO.** of Chicago has opened a sales office at 173 Orange St. in New Haven, Conn. Richard Hesse is in charge . . . **HARTLEY PRODUCTS CO.** has tripled the area of its New York plant to deal with the accelerated demand for its 217 full-range speaker. The company is also using plant facilities in Michigan for cone treatment and research . . . The combined offices of **WESCON,** the Los Angeles Section of the **IRE,** and the **WCEMA** have been moved to new and larger quarters at 1435 S. La Cienaga Blvd. in Los Angeles . . . **HELIPOT DIVISION** of **BECKMAN INSTRUMENTS, INC.** has dedicated its new 3 million dollar facility in Newport Beach, Calif. The 156,000 square foot ultra-modern building houses manufacturing and administrative facilities . . . **INDUSTRO TRANSISTOR CORP.** has acquired additional new plant facilities at 35-10 36th Ave., Long Island City, N. Y. Production lines for the manufacture of germanium-junction alloy transistors will be established at the new site . . . **MERIT COIL AND TRANSFORMER CORPORATION** is building a 12,000 square foot addition to its Hollywood, Florida plant. The new addition will provide warehousing facilities to serve southeastern distributors and the Latin American market . . . **SPRAGUE ELECTRIC COMPANY** is expanding its Pacific Coast manufacturing facilities with the construction of a new plant of more than 21,000 square foot capacity at Visalia, Calif. The new factory will house all manufacturing facilities presently located at the Venice, Calif. headquarters . . . **MOTOROLA COMMUNICATIONS & ELECTRONICS INC.** has built a new Dallas, Tex. administrative headquarters which will administer the ten-state southern sales area. The building, complete with parking area for 42 cars, has been constructed on a 42,000 square foot tract of land in the Brook Hollow Industrial District about five miles from downtown Dallas . . . Ground has been broken at the site of the new **CBS LABORATORIES** in Stamford, Conn. When completed, the million-dollar building will provide research and development facilities for a scientific and administrative staff of 150 persons. The laboratory is on High Ridge Road near the Merritt Parkway.

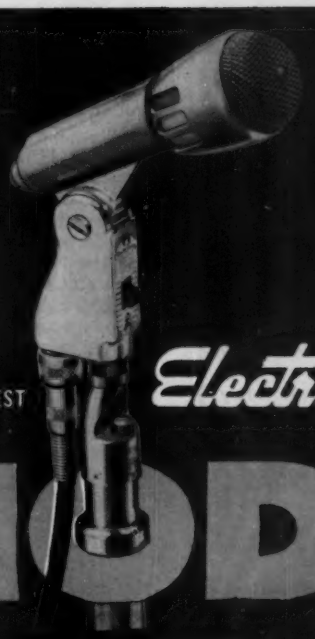
• • •

J. BURTON HENRY has been appointed sales manager of the new products division of *International Resistance Company* of Philadelphia. He will also continue to serve in his present capacity as sales administrator.

He joined the company in 1944 and since then has held a variety of positions. During World War II he was with the Army-Navy Electronics Production Agency. Previously he had been associated with *Brunswick Radio Company, Kolster Radio Company, and Atwater Kent.*

Mr. Henry attended the Towne Sci-

NEW! CRYSTAL! CARDIOID! COMPETENT!

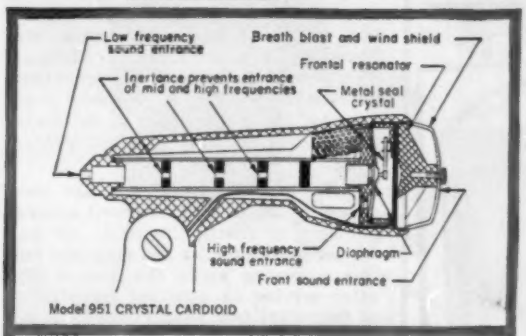


NEWEST Electro-Voice VARIABLE-D MICROPHONE

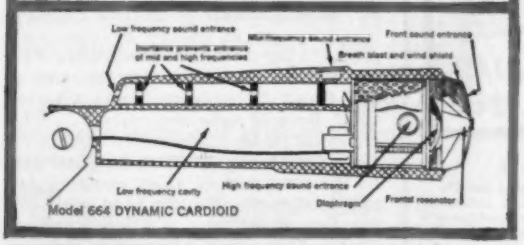
MODEL 951

$49.50 LIST, LESS STAND

NEW Model 951 Crystal Cardioid. This latest addition to the E-V line uses the same Variable-D principle as E-V's broadcast cardioids. It assures uniform directivity and high discrimination. Response is 50 to 11,000 cps. Has chrome-finished, pressure-cast case, on-off switch. Just $49.50 list, less stand.

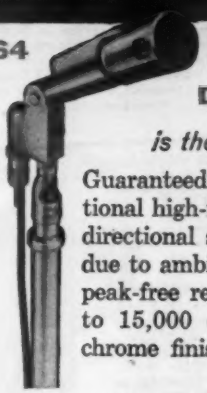


Model 951 CRYSTAL CARDIOID



Model 664 DYNAMIC CARDIOID

MODEL 664



DYNAMIC CARDIOID

is the finest of its kind!

Guaranteed to outperform all others. Unidirectional high-fidelity Model 664 produces highly directional sound selectivity; reduces pick-up due to ambient noise up to 50%; has smooth, peak-free response at all frequencies from 40 to 15,000 cps. Convenient on-off switch, chrome finish.....$85.00 List, less stand.

ELECTRO-VOICE OFFERS THESE HIGHLY INFORMATIVE BOOKLETS FOR THE PROPER SELECTION OF MICROPHONES...

The ABC's of Microphones. Explains in detail the various applications of all types of microphones. Tells how to get the best results in each application. *Write for Bulletin N82.*

Public Address and General Purpose Microphone Catalog. Packed with information on Electro-Voice P.A. and G.P. mikes. Illustrations and prices included. *Write for Bulletin N82.*

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Convince yourself at no risk that CENTURY instruments are indispensible in your every day work.

SHIPPED ON APPROVAL
SEND NO MONEY — NO C.O.D.

Examine instruments for 10 days before you buy . . . Only then, when satisfied pay in "easy to buy" monthly installments.

Just 2 settings on the NEW FAST-CHECK TUBE TESTER

Model FC-1

tests all tubes completely, accurately and in seconds — RIGHT ON THE SPOT

The FC-1 is the only tube tester in its price range to give a complete tube test of over 600 tube types in seconds without multiple switching or annoying checking of roll charts. You make every call pay extra dividends by merely showing your customer the actual condition and life expectancy of the tube. The extra tubes you sell each day will pay for the FAST-CHECK in a very short time.

WIDE RANGE OF OPERATION

Checks quality of over 600 tube types, which covers more than 99% of all TV and radio tubes in use today, including the newest series-string TV tubes, auto battery-type 12 plate-volt tubes, 0Z4s, magic eye tubes and gas regulators ■ Checks for cathode-heater and cathode-grid shorts and detects inter-element leakage up to 1.5 megohms ■ Checks for life expectancy.

handsome hand-rubbed oak carrying case

Save valuable servicing time and earn extra money with the FC-1

Model FC-1W factory wired $58.50 Net

Model FC-1K semi-kit form $48.50 Net

Model AD-1 PICTURE TUBE ADAPTER – Also available for the FC-1. Checks all picture tubes (including the new short-neck 110 degree RCA-type picture tubes) for cathode emission, shorts and life expectancy. Also rejuvenates and restores cathode emission of weak picture tubes.
Model AD-1 (factory wired only).....$4.50

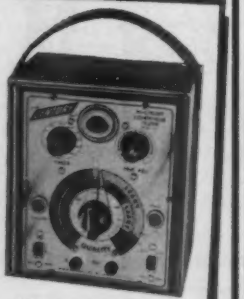
OUTSTANDING VALUE FEATURES

Checks each section of multi-purpose tubes simultaneously. If one section is defective the tube will read "Bad" on the meter scale ■ 41 tube sockets accommodate all present and future tube types ■ Less than 10 seconds required to test any tube ■ Large D'Arsonval type meter is extremely sensitive, yet rugged . . . with two multi-color "Good-Bad" scales ■ Selection of 12 filament voltages ■ Line isolated ■ 7-pin and 9-pin straighteners mounted on panel ■ Large easy-to-read quick reference chart for over 600 tube types in use today ■ New tube listings furnished periodically.

Here's an *in-circuit* condenser tester that *does the whole job!*

The IN-CIRCUIT CONDENSER TESTER Model CT-1

Actually steps in and takes over where other in-circuit condenser testers fail. The tremendous range of operation makes it an absolute must for every serviceman.



Checks in-circuit: Quality . . . including *leakage*, shorts, opens, and intermittents ■ Value of all condensers 200 mmfd. to .5 mfd. ■ Electrolytics for quality — any size ■ Transformer, socket and wiring leakage capacity.

Checks out-of-circuit: Quality . . . including *leakage*, shorts, opens and intermittents ■ Value of all condensers 50 mmfd. to .5 mfd. ■ Electrolytics for quality — any size ■ High leakage to 300 megohms ■ New or unknown condensers.

JUST A FEW FEATURES OF THE CT-1

Ultra-sensitive 2 tube drift-free circuitry ■ Multi-color scale gives simultaneous readings of both *quality* and *value* *in-circuit* or *out-of-circuit* ■ Cannot damage circuits ■ Electronic eye balance indicator for even greater accuracy ■ Line isolated ■ Fully shielded.

Model CT-1W factory wired $34.95 Net

Model CT-1K kit form $24.95 Net

CENTURY ELECTRONICS CO., INC.

111 Roosevelt Ave.
Dept. 202, Mineola, N. Y.

Please rush the instruments checked for a 10 day examination period. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instrument within 10 days and there is no further obligation. It is understood there will be NO CARRYING CHARGES. Should I fail to make payment when due, the full unpaid balance shall become due and payable at once.

Name.....

Address.....

City.....State.....

Prices Net F.O.B. Mineola, N. Y.

- ☐ Model FC-1W (wired).....$58.50 $14.50 within 10 days. Balance $11.00 monthly for 4 months.
- ☐ Model FC-1K (semi-kit)....$48.50 $12.50 within 10 days. Balance $9.00 monthly for 4 months.
- ☐ Model AD-1 CRT Adapter....$4.50
- ☐ Model CT-1W (wired).....$34.95 $9.95 within 10 days. Balance $5.00 monthly for 5 months.
- ☐ Model CT-1K (kit).....$24.95 $8.95 within 10 days. Balance $5.00 monthly for 3 months.

entific School of the University of Pennsylvania. He is president of the Philadelphia Chapter of the Armed Forces Communications and Electronics Association.

* * *

DONALD G. FINK, director of research of *Philco Corporation,* has been elected president of the Institute of Radio Engineers for 1958. He succeeds John T. Henderson, principal research officer of the National Research Council, Ottawa, Canada, as head of this international society of 62,000 radio engineers and scientists.

Serving with Mr. Fink is Carl-Eric Granqvist, director of *Svenska Aktiebolaget Gasaccumulator,* Stockholm-Lidingo, Sweden who succeeds Yasujiro Niwa of Tokyo as vice-president.

Elected as directors for the 1958-1960 term are G. S. Brown, professor and head of the Department of Electrical Engineering at MIT and W. H. Doherty, assistant to the president of *Bell Telephone Laboratories, Inc.*

* * *

ROBERT D. BROWNING, former recording engineer for *RCA Victor Records,* has joined the research and engineering staff of *ORRadio Industries.*

His most recent connection was with *RCA* in Chicago where he was chief engineer and manager of recording. He joined the company in New York City as a technician after three years service in the Army Signal Corps during World War II. He was later promoted to recording engineer.

A native of Selma, Alabama, Mr. Browning is a graduate of Alabama Polytechnic Institute at Auburn where he received his B.S. in electrical engineering. He is a member of the Audio Engineering Society.

* * *

DANIEL P. KNOWLAND, JR. has been upped to the post of assistant general manager of *Heath Company.* He was formerly comptroller and assistant secretary, having joined the firm in 1955 after serving as assistant comptroller of *Daystrom, Inc.,* parent firm to *Heath* . . . **JAMES HERVEY** is the new marketing manager in charge of consumer products for *American Electronics, Inc.* He will be responsible for the sale of the firm's "Concertone" and "American" lines of tape recorders . . . The *Hoffman Radio Division* has announced the appointment of **TOM E. MUMFORD** to the new post of sales manager for hi-fi and radio. He has been with the firm since 1952 . . . *Elgin National Watch Company's* electronics division is the responsibility of **DONALD A. SUTHERLAND** who has recently been named general manager . . . **SAM NORRIS,** president and chairman of the board of *Nuclear Corporation of America, Inc.,* has been named assistant director of the Electronics Division, Business and Defense Administration, U. S. Department of Commerce . . .

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Discover the Hidden Music In Your FM Dial with NEW

JERROLD FM Range Extender!

Simply connect a Jerrold FM Range Extender between the antenna and your FM tuner or receiver... *and enjoy all the FM stations you've wanted to hear!* Jerrold's FM Range Extender pre-amplifiers boost the strength of signals at the antenna 18 times... bring in distant stations you never heard before... increase the enjoyment of stations you now receive.

Features:

★ 20 DB S/N ratio with 0.6 μv input

★ High RF gain and output

★ Full FM band width

Available in two models for either indoor or outdoor operation.

Indoor Model 406A-FM

USE YOUR TV ANTENNA TO IMPROVE FM RECEPTION

Use Jerrold's popular low-cost MULTI SET COUPLER to connect your FM receiver to your TV antenna... for greater FM pleasure.

See The Jerrold FM RANGE EXTENDER and MULTI SET COUPLER at leading distributors or write:

JERROLD ELECTRONICS CORPORATION

Dept. PD 27, Philadelphia 3, Pa.

The Semiconductor Division of *Hoffman Electronics Corporation* has named **PERRY L. TOBACK** as head of application engineering and **RICHARD L. WHITE** to the application engineering group . . . **LEE GUNTER, JR.** has been named chief development engineer of *Shure Brothers, Inc.* while **ROBERT TROXEL** has been appointed chief products engineer for the firm . . . **SAM P. KARR** has been named editor of the "NEDA Journal," monthly publication of the National Electronics Distributors Association . . . The appointment of **DONALD W. COLLINS** to the newly created position of special sales representative, high-fidelity instruments, has been announced by the radio and television division of *Sylvania Electric Products Inc.* . . . The board of directors of *International Resistance Company* has elevated **WALTER H. POWELL**, director of industrial relations, to a vice-presidency . . . *Minnesota Mining & Manufacturing Co.* has promoted **ALBERT J. BLOWER** to the post of Los Angeles branch sales manager of its magnetic products division. He has been with the branch since 1953 . . . **LEE J. GOODMAN** has been named industrial sales manager of *Newark Electric Company's* newly expanded west coast branch in Inglewood, Calif. . . . *P. R. Mallory's* electronic division has appointed **T. M. FITZGERALD** to the post of general sales manager.

• • •

JOSEPH F. DEGEN has been named vice-president in charge of manufacturing for the *Weston Electrical Instrument Corp.*, a subsidiary of *Daystrom, Inc.*

Prior to his new appointment, Mr. Degen was manufacturing superintendent for *International Business Machines Corp.* at its Poughkeepsie plant. He joined *IBM* in 1946 and was appointed superintendent in 1953. Prior to that he spent seven years in a civilian capacity with the Ordnance Department at Watervliet Arsenal.

He is a member of the A.S.M.E., the American Society for Quality Control, and the American Management Association. He will make his headquarters at the Newark, N. J. plant.

• • •

INSTITUTE OF RADIO ENGINEERS has announced that the 1958 W.R.G. Baker Award will be given to R. L. Kyhl and H. F. Webster of the *General Electric Company* Research Laboratory for their paper entitled "Breakup of Hollow Cylindrical Electron Beams" which appeared in the October 1956 issue of "IRE Transactions on Electronic Devices." The award is given annually to the author or authors of the best paper published in the "Transactions of the IRE Professional Groups."

Arthur Karp of *Bell Telephone Laboratories, Inc.*, Holmdel, N. J. was named recipient of the 1958 Browder

(*Continued on page* 168)

the experts say... in High Fidelity the best buys are EICO

EICO KITS and WIRED

BETTER ENGINEERING Since 1945 EICO has pioneered the concept of test instruments in easy-to-build kit form — has become world-famous for laboratory-precision instruments at low cost. Now EICO is applying its vast experience to the creative engineering of *high fidelity*. Result: high praise from such authorities as Canby of AUDIO, Marshall of AUDIOCRAFT, Holt of HIGH FIDELITY, Fantel of POPULAR ELECTRONICS, Stocklin of RADIO TV NEWS, etc. — as well as from the critical professional engineers in the field.†

SAVE 50% Mass purchasing, and a price policy deliberately aimed to encourage mass sales, make this possible.

EASY INSTRUCTIONS You need no previous technical or assembly experience to build any EICO kit — the instructions are simple, step-by-step, "beginner-tested."

DOUBLE 5-WAY GUARANTEE Both EICO, and your neighborhood distributor, guarantee the parts, instructions, performance . . . as well as *lifetime* service and calibration at nominal cost . . . for any EICO kit or wired unit.

BEFORE YOU BUY, COMPARE At any of 1200 neighborhood EICO distributors coast to coast, you may examine and listen to any EICO component. Compare *critically* with equipment several times the EICO cost — then *you* judge. You'll see why the experts recommend EICO, kit or wired, as best buy.

†Thousands of unsolicited testimonials on file.

HF52 Standard Speaker System — revolutionary new generic type of system — incorporates the slot-loaded conical horn** and omni-directional cone tweeter.** More sonic detail, more **naturally**, throughout the audio spectrum. No other commercially available system approaches it in over-all musical quality & technical excellence. 45-20,000 cps essentially flat; clean useful range 30-40,000 cps. Impedance 16 ohms. HWD: 36" x 15¼" x 11½". **In Walnut or Mahogany, $139.95. In Blonde, $144.95.**

HFT90 FM Tuner equals or surpasses wired tuners up to 3X its cost. New, pre-wired, pre-aligned, temperature-compensated "front end" — drift-free. Sensitivity, 1.5 uv for 20 db quieting, is 6X that of other kit tuners. DM-70 traveling tuning eye. Response 20-20,000 cps±1 db. Cathode follower & multiplex outputs. **Kit $39.95*. Wired $65.95*. Cover $3.95.** *Less cover, excise tax incl.

HF61A Preamplifier, providing the most complete control & switching facilities, and the finest design, offered in a kit preamplifier, " . . . rivals the most expensive preamps . . . is an example of high engineering skill which achieves fine performance with simple means and low cost." — Joseph Marshall, AUDIOCRAFT. **HF61A Kit $24.95, Wired $37.95, HF61 (with Power Supply) Kit $29.95. Wired $44.95.**

HF60 60-Watt Ultra Linear Power Amplifier, with Acro TO-330 Output Transformer, provides wide bandwidth, virtually absolute stability and flawless transient response. " . . . is one of the best-performing amplifiers extant; it is obviously an excellent buy." —AUDIOCRAFT Kit Report. **Kit $72.95. Wired $99.95. Matching Cover E-2 $4.50.**

Prices 5% higher in the West

HF50 50-Watt Ultra-Linear Power Amplifier with extremely high quality Chicago Standard Output Transformer. Identical in every other respect to HF60 and same specifications up to 50 watts. **Kit $57.95. Wired $87.95. Matching Cover E-2 $4.50.**

HF30 30-Watt Power Amplifier employs 4-EL84 high power sensitivity output tubes in push-pull parallel, permits Williamson circuit with large feedback & high stability. 2-EZ81 full-wave rectifiers for highly reliable power supply. Unmatched value in medium-power professional amplifiers. **Kit $39.95. Wired $62.95. Matching Cover E-3 $3.95.**

HF-32 30-Watt Integrated Amplifier Kit $57.95. Wired $89.95.

HF32 50-Watt Integrated Amplifier with complete "front end" facilities and Chicago Standard Output Transformer. Ultra-Linear power amplifier essentially identical to HF50. The least expensive means to the highest audio quality resulting from distortion-free high power, virtually absolute stability, flawless transient response and "front end" versatility. **Kit $69.95. Wired $109.95. Matching Cover E-1 $4.50.**

HF20 20-Watt Integrated Amplifier, complete with finest preamp-control facilities, excellent output transformer that handles 34 watts peak power, plus a full Ultra-Linear Williamson power amplifier circuit. Highly praised by purchasers, it is established as the outstanding value in amplifiers of this class. **Kit $49.95. Wired $79.95. Matching Cover E-1 $4.50.**

HF12 12-Watt Integrated Amplifier, absolutely free of "gimmicks", provides complete "front end" facilities & true fidelity performance of such excellence that we can recommend it for **any** medium-power high fidelity application. Two HF12's are excellent for stereo, each connecting directly to a tape head with no other electronic equipment required. **Kit $34.95. Wired $57.95.**

HFS1 Two-Way Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps ± 6 db. Capacity 25 w. Impedance 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. **Price $39.95.**

THE HI-FI EXPERTS SAY:

"For those who have been looking for a well-engineered yet inexpensive power amplifier, the newly-released EICO Model HF20 unit might offer a simple solution to their problem. Not only does this unit provide 20 watts of power but the circuit incorporates a preamplifier and a variety of controls on a single chassis."
William A. Stocklin, Editor, RADIO TV NEWS

"The new EICO 'standard' speaker system . . . produces sound that to my musical ears rates as excellent, from high top to clean low bottom."
Edward Tatnall Canby, AUDIO Magazine

TURN PAGE FOR OTHER EICO AD.

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the specs prove it . .
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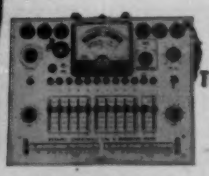
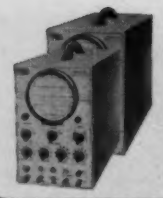


***NEW!* DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666**

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication of Gm, Gp & peak emission. Simultaneous sel of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**



5" PUSH-PULL OSCILLOSCOPE #425

KIT $44.95 **Wired $79.95**

•

7" PUSH-PULL OSCILLOSCOPE #470

KIT $79.95 **Wired $129.50**

TUBE TESTER #625

KIT $34.95 **Wired $49.95**

- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter **$4.50**

6V & 12V Battery Eliminator & Charger #1050:

KIT **$29.95** **Wired $38.95**

for transistorized eqpt, #1080:

KIT **$38.95, Wired $47.95**

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.

KIT $24.95

Wired $39.95

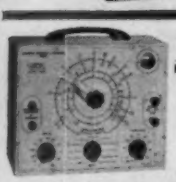
DELUXE MULTI-SIGNAL TRACER #147

20,000 Ohms/Volt MULTIMETER #565

KIT 24.95 **Wired $29.95**

1000 Ohms/Volt MULTIMETER #536

KIT $12.90 **Wired $14.90**



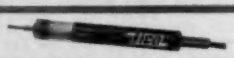
Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.

KIT

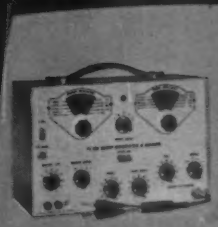
$19.95

Wired $29.95

R-C BRIDGE & R-C-L COMPARATOR #950B



VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$8.95
RF	$3.75	$4.95
High Voltage Probe-1		$8.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75



***NEW!* COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460**

KIT $79.95 WIRED $129.50

- **Features DC Amplifiers!**

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig control. Retrace blanking. Phasing control.

***NEW!* TV-FM SWEEP GENERATOR & MARKER #368**

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **incremeter** for excellent linearity. **Extremely flat RF output: new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in 5 **fund. bands. Variable Marker Range** 2-75 mc in 3 **fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

***NEW!* RF SIGNAL GENERATOR #324**

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower for** improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

***NEW!* PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)**

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

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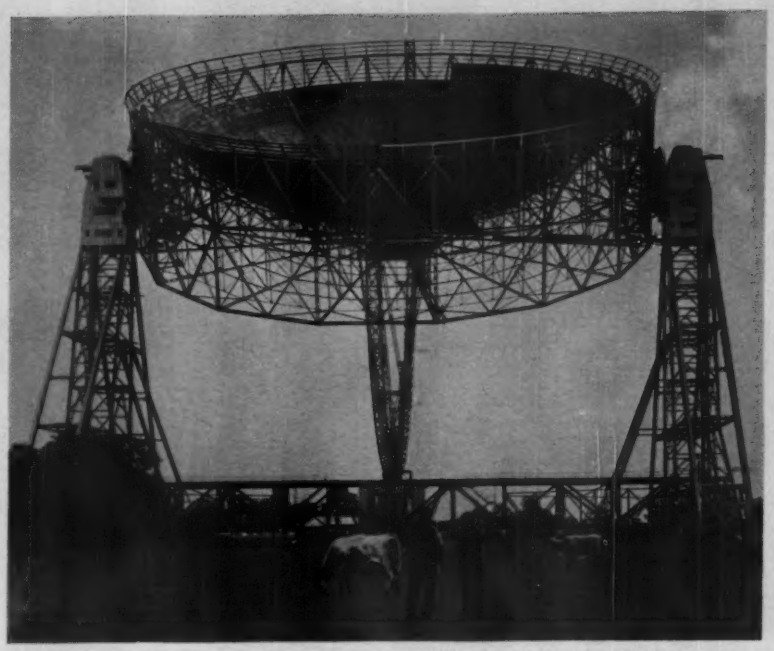
RADIO ASTRONOMY and the Jodrell Bank Radio Telescope

By
A. C. B. LOVELL
Director, Jodrell Bank Experimental Station



Giant 250-foot radio telescope, standing amid Cheshire farmland, is tilted for recent tests.

The complete story about the powerful new tool that has been making headlines tracking the Soviet satellite.

THE great steerable radio telescope which has been built at Jodrell Bank in Cheshire, England, for the University of Manchester has recently been put in operation. It is to be used with two distinct types of radio equipment for the exploration of the universe: first, as a receiver to pick up the radio waves which are generated in the remote parts of the universe, and second as a combined transmitter and receiver for investigations within the solar system using the radio echo or radar technique. It was this latter that was recently made such good use of in the tracking of the Soviet earth satellites that were launched a few months ago.

First of all, however, it may be useful to say a few words about the fundamental reasons which led to the idea of such a huge and expensive instrument.

The exciting discoveries in astronomy have depended mainly on the development of optical telescopes of ever-increasing size. These large telescopes require unusual climatic conditions if their potentialities are to be realized; the great telescopes of the twentieth century have been built in America at Mt. Wilson and Palomar.

The 100-inch telescope on Mt. Wilson came into operation just after the First World War and, in the hands of the American astronomers, it revealed a universe of unforeseen immensity. Hitherto, the assemblage of stars was believed to be contained in a relatively small volume some few thousand light years in extent, with the sun and planets near the center. The many nebulae to be seen in the telescopes were thought to be diffuse objects lying within this system. But this new telescope revealed that the Milky Way system, or local galaxy, was disc-like in structure, extending for 100,000 light years across its plane and containing about 10,000 million stars. Moreover, Hubble's investigations with the telescope soon convinced his colleagues that many of the nebulae were external to this system, and that the nearest one in Andromeda must be separated from the local star system by over a million light years, and must also contain a vast number of stars. Other nebulae were shown to be similar star systems at even greater distances. Nowadays, it is known that the 200-inch telescope on Mt. Palomar can see nebulae out to distances of hundreds of millions of light years, and within the field of view there must lie an enormous number of galaxies—perhaps of the order of a thousand or ten-thousand million.

EDITOR'S NOTE: *We are proud to welcome to these pages one of the world's leading authorities in the new science of radio astronomy. A. C. B. Lovell, O.B.E., F.R.S. is Professor of Radio Astronomy at the University of Manchester in England and has been Director of Jodrell Bank Experimental Station since 1951.*

Born in 1913, Lovell attended school in Bristol as well as the University of Bristol. He began his teaching career in 1936 at the University of Manchester, worked at the Telecommunications Research Establishment from 1939 to 1945, and has since been teaching at the University of Manchester.

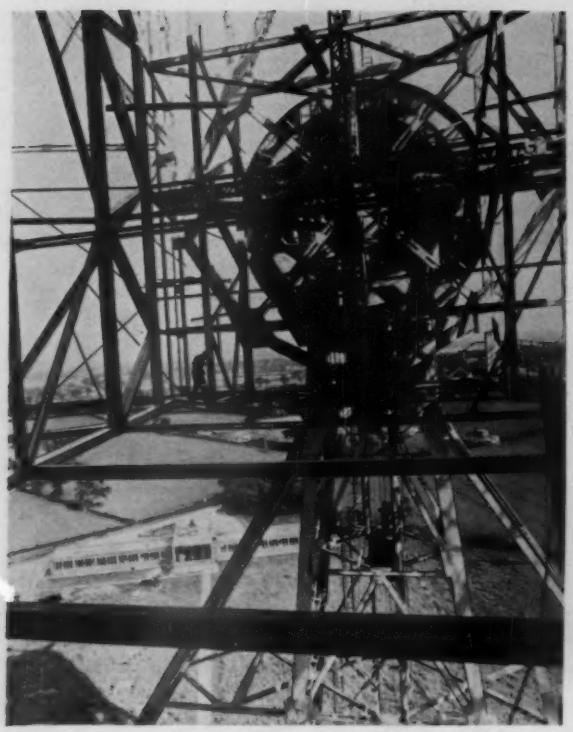
In 1946, he was awarded the Order of the British Empire and in 1955 was made Honorary Foreign Member of the American Academy of Arts and Sciences and Fellow of the Royal Society.

Among the books he has written are "World Power Resources and Social Development," "Radio Astronomy," and "Meteor Astronomy." Many of his articles have been published in leading physical and astronomical journals.

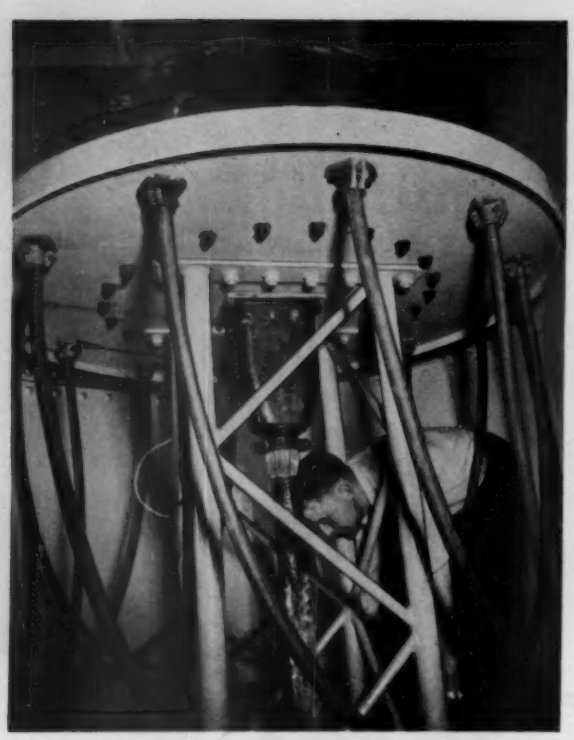
Origin of Radio Astronomy

In the face of this penetration to the remote depths of space it seemed hardly possible a few years ago that the remaining tasks of observational astronomy could be other than the detailed study of the individual stars and nebulae as seen in the conventional telescopes. But by a strange twist of fate the Second World War was to place a new and enormously powerful tool in the hands of astronomers for the exploration of space, and the recent discoveries have rivaled in excitement those made in the last twenty years with the ordinary telescopes.

Almost all astronomical research has been carried out with telescopes and other instruments receiving light waves emitted by the stars in the visual part of the electromagnetic spectrum. Various auxiliary instruments such as photoelectric cells have been used to extend the studies a little beyond the visual limits into the infrared and ultraviolet regions, but appreciable extension is prohibited by the absorption caused by water



Here is a view of one of the great trunnions on which the giant reflector bowl turns with the control building far below.



The method by which the cables are brought on to the moving portion of the radio telescope. Slip rings are not used.

vapor and fine dust in the earth's atmosphere. Thus, our knowledge of the universe has arisen almost entirely from the study of stellar emissions in this narrow visual and near-visual region of the spectrum.

It was, therefore, surprising when an American engineer, Jansky, discovered at the end of 1931 that radio waves, apparently emanating from regions beyond the solar system, were reaching the earth. Jansky's work caused little immediate interest and the only important additions to his results before the Second World War were made by Grote Reber, an amateur investigator who constructed the first radio telescope of the type with which we are familiar today. It was 30 feet in diameter and received radio waves on a wavelength of about two meters. The instrument could readily be pointed to different parts of the sky and with it Reber confirmed Jansky's discovery that radio waves were reaching the earth from outer space.

He found that the radio signals were strongest from directions near the center of the local galaxy and along the plane of the Milky Way, in fact, that the radio signals were roughly proportional in strength to the concentration of stars in the direction in which the radio telescope was pointing. On the other hand Reber failed completely to detect any signals from the bright stars or from other prominent features visible in telescopes.

Even today, after many years of rapid technical development, only a very few objects identifiable in the large telescopes are known to be the source of some of these radio emissions. Apart from the sun, no one has yet found radio emission from any common type of star. On the other hand, the rare supernovae, or the gaseous remains of exploded stars in the Milky Way, are known to be radio emitters. Probably most of the radio waves in the Milky Way come from such types of object together with that generated in the interstellar gas which fills the space between the stars. The reason why most of the radio sources, or radio stars, have not been identified is now believed to arise from their very great distances which put them beyond the range of even the largest optical telescopes. For example, the second most powerful radio source in the sky lies in the constellation of Cygnus, and this has been identified as the collision of two entire galaxies of stars at a distance of 200 million light years. This is about the useful limit of penetration of the 200-inch optical telescope on Mt. Palomar, and it seems possible that many of the weaker radio sources may be similar cases of galaxies in collision at even greater distances. We shall return to this when discussing the uses of the new radio telescope.

New Radio Telescope

The study of the radio emissions from space is carried out on a wavelength a million times longer than the wavelength of the light waves which are focussed by the conventional optical telescopes. The radio waves are unaffected by cloud, fog, or daylight and, in this respect, the radio astronomer has a marked advantage over the traditional methods of astronomical investigation. On the other hand, because of the long wavelength, it is extremely difficult to achieve any appreciable resolution. The beam width, or the angle of the cone in which the radiation is received, depends on the ratio of the wavelength to the diameter of the telescope. Thus to achieve the same resolution as a very small optical telescope, the aerials of a radio telescope would have to extend for thousands of miles. The need for the maximum possible resolution in the radio work has been a dominant feature of the technical developments. A great deal has been achieved by special devices in which two similar aerial systems, spaced by several hundred yards, are connected to common recording equipment. This type of radio telescope, known as an interferometer, has been developed in Cambridge (England) and Sydney.

In an alternative approach, the physical size of the aerial system is increased. There are now several steerable radio telescopes of small size in existence. Many years ago a large radio telescope with an aperture of 220 feet was constructed at Jodrell Bank, but this was fixed to the earth and could be used only to explore a small part of the heavens. Experience with this instrument soon demonstrated the vital role which could be

played by a completely steerable telescope of this order of size. The engineering difficulties and expense of such an undertaking are formidable. Nevertheless, the results to be anticipated were such as to enlist the sympathetic interest of many prominent scientists when the idea was first put forward in 1949.

Telescope Crucial Instrument: In conventional astronomical investigations, the telescope has been the crucial instrument for the exploration of space. Successive increases in size have led to more light-gathering power and greater resolution, and although the improvements in auxilliary instruments, such as photographic plates and spectroscopes, have been very important, nevertheless the great advances in observational astronomy have come primarily from larger and larger telescopes. The situation in radio observations is very similar: whereas large optical telescopes are required to improve the light-gathering power and the resolution, large radio telescopes are required in order to be able to pick up faint signals at greater distances from the earth as well as for greater resolution.

The new telescope is essentially a paraboloidal steel bowl 250 feet in diameter, with the focus in the aperture plane, built so that it can be directed towards any part of the sky. In principle the motion of the telescope is altazimuth. The bowl, which weighs about 700 tons, is driven in elevation by a *Ward-Leonard* system through two 27-foot racks from the dismantled battleship "Royal Sovereign." These are mounted 170 feet above ground on two towers which themselves rotate on a 350-foot railway track to give the motion in azimuth. The drive is via two railway trucks under each tower, again through a *Ward-Leonard* system. Four additional trucks, which are undriven, serve as wind carriages on each side of the structure. The towers are connected near ground-level through a heavy diametral girder system supported on the central pivot, which is the fundamental locating point of the telescope. The power and instrumental cables come through this central pivot into a motor room situated within the diametral girder immediately above the central pivot. This room contains the motor generator sets and controls for the *Ward-Leonard* system that is employed.

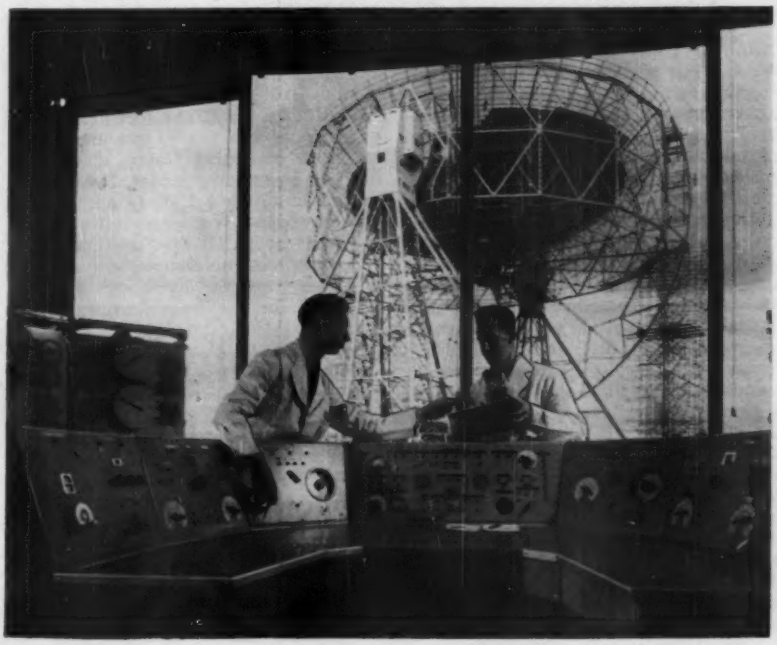
17-Foot Gauge Double Track: The 17-foot gauge double railway track on which the telescope rotates is mounted on deep-piled foundations which extend, in some places, 90 feet underground. The various power, control, and instrumental cables are taken into an annular laboratory underneath the central pivot and then through an underground tunnel to the control room. This control room houses the main control racks and console. The computer system consists of magslip resolvers working in servo loops to solve the necessary equations in order that the telescope can be given a sidereal movement. A wide range of movements can be selected at the control desk; for example, automatic sidereal motion at a given right ascension and declination, motion in galactic latitude and longitude, straightforward motion in azimuth and elevation, and various automatic scanning movements with a choice of rasters. Parallax corrections can also be introduced when it is desired to track a body in the solar system. There are no slip rings so that the danger of creating electrical interference is avoided, and the limit of motion is 420 degrees, after which an automatic reversal takes place.

The specification calls for a tracking accuracy of at least 12 minutes of arc at speeds up to 4 degrees per minute. The maximum slewing speed is about 22 degrees per minute in azimuth and elevation. The position of the telescope in azimuth and elevation is repeated back to the control room through magslips driven by accurately machined chain racks independently of the driving system. The specification requires these positions to be repeated to an accuracy of $\pm$ 1 minute of arc.

Reflecting Membrane 1/12" Thick Steel: The reflecting membrane is of 1/12-inch thick steel sheet welded from 7000 individual sections of about 3 ft. x 3 ft. onto the purlins of the steel framework. It has been essential to ensure good conductivity across these welded sections, otherwise the membrane would become very "lossy" at certain wavelengths. The primary aerial feed is carried at the focus on a steel tower built up 62½ feet from the apex of the paraboloid. This tower diminishes in cross-section rapidly with height in order to avoid obscuration and scattering from the primary feed. It was, however, essential to design it with sufficient stiffness so that no displacement occurred as the bowl turns over. An important scientific requirement is that easy access can be obtained to the primary feed so that the operational wavelength can be changed readily. Originally it was intended to have an access tower which could move out on tracks on top of the diametral girder to put the operator in reach of the aerial when the bowl was inverted. This was later abandoned in favor of a system whereby the aerial is mounted on a 50-foot steel tube which slides into the top of the aerial tower. With the bowl inverted this can be winched down to ground-level and replaced by another 50-foot tube complete with aerial system. The radio-frequency cables from the aerial run inside this tube and can be reached from a small platform near the base of the tower when the bowl is facing towards the zenith.

In much of the work it will be necessary to mount the radio-frequency preamplifiers and other parts of the receiving equipment as close as possible to the aerial. These essential units will be contained in a small laboratory which swings underneath the bowl. Further laboratory space is available at the tops of the two towers, but even from those the minimum length of cable run to the primary feed is about 200 feet. Other scientific apparatus will be installed on the base girders; but the main recording apparatus will be in labora-

Here is a view of the Jodrell Bank radio telescope which has been taken from the operating console at which the controller sits. During the night the great telescope is illuminated by floodlights in order that the controller may be able to keep everything in view and monitor the position of the immense bowl.



tories that are situated adjacent to the control room.

The theoretical curves showing the beam width and power gain as a function of wavelength are given in Fig. 1. Calculations have been made of the effect of irregularities in the membrane on the power gain, from which it is clear that, except at very short wavelengths for which the telescope is not primarily designed, large distortions are permissible without any appreciable effect on the performance of the telescope. During the next few months it is hoped to begin the scientific program by establishing these curves on an experimental basis by observing certain radio sources at different azimuths and elevations over a range of wavelengths.

Immediate Tasks

A common feature of the surveys of radio stars in both northern and southern hemispheres is the failure to associate all but a few with celestial objects visible in the large telescopes. For example, a recent Cambridge survey located 1936 radio stars, 1906 of which were of small angular diameter and distributed isotropically. Only a few per-cent of these have been successfully associated with known objects and the surveys in the southern hemisphere by the Sydney group give similar results.

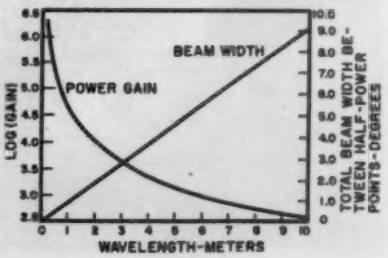
The spatial distribution of these unidentified radio stars has been investigated by plotting *log N* against *log I* where *N* is the number of radio sources per unit solid angle with an intensity greater than *I*. If the sources are distributed uniformly throughout space it is easy to show that the plot should give a straight line of slope −1.5, so that any departure from this relationship will give information about the variation of spatial density with distance. The results of the *log N/log I* Cambridge plots are very surprising. There is a marked departure from the expected slope, the experimental curve becoming steeper for low intensities until a flattening due to instrumental limitations occurs. The implication is that the spatial density of radio stars is constant in the neighborhood of the solar system but progressively increases with distance. It is impossible to account for this result and for the isotropy of the sources other than by assuming that the increase in slope is taking place at distances which are comparable with the limits of observation of the 200-inch telescope. If, in fact, this spatial distribution is due to processes on a cosmical scale, then the results have a significant bearing on cosmological theories. In the steady-state or continuous-creation theories the density of nebulae should be everywhere the same and independent of time and space, since new galaxies are continually being formed to take the place of those which move out of the field of view as a result of the expansion of the universe. On the other hand, in the evolutionary theories the spatial density decreases progressively with time. In this case we should expect to find a greater concentration of nebulae near the limits of the observable universe which corresponds to a period of time some 2000 million years ago.

Lead to Further Conclusions: This is precisely the result which appears in the radio star distribution, but since the radio emission from individual nebula is too weak to be detected at such distances we are led to further conclusions about the nature of these radio sources. Galactic collisions of the Cygnus type can be shown to produce radio emission of the order of magnitude required, and the suggestion is that these sources are colliding galaxies probably lying beyond the limit of penetration of the 200-inch telescope. This is consistent with the interpretation of the *log N/log I* curve, since at the time of several thousand million years ago both the spatial density and the number of colliding galaxies must have been much greater than at present.

This interpretation of the *log N/log I* curve for the observed radio sources is therefore in favor of the evolutionary cosmological theories. This conclusion is, at present, in very great dispute, particularly as the preliminary results of the Sydney survey do not entirely agree with those obtained in Cambridge. The issue is of the utmost importance, carrying with it the possibility of a significant contribution to the main cosmological problem of the origin of the universe. Before agreed conclusions can be reached, the validity of the data must be greatly increased, and this program can be expected to form a very prominent aspect of the work of the new telescope. In the program as planned now, the telescope will be used on a frequency of 168 mc. as an element in an interferometer to measure the actual angular extent of the sources so that the effective temperatures of the individual sources can readily be determined.

Additional Uses: The foregoing is an example of the use of the new telescope in programs where it will be used as a receiving aerial. In addition to this cosmological study on 168 mc. the telescope is equipped with receiving systems on 90, 408, and 1420 mc. for surveys of the distribution of radio emission from the local galactic system and for the investigation of the strength of the radio waves emitted by various types of normal extragalactic nebulae.

Fig. 1. Calculated power gain and beam width of the 250-foot aperture radio dish.



In addition to this type of work the telescope will be used as a combined transmitting and receiving aerial. In these radar or radio-echo aspects of the work, the moon, artificial satellites, and the planets will certainly figure prominently.

The moon echo experiments show that the radio echoes are subject to deep and rapid fading—an effect which is now believed to be due to a peculiarity of the moon's motion with respect to the earth, known as libration. The lunar echo apparatus at Jodrell Bank works on a frequency of 120 mc. and uses a transmitter giving 10 kw. in 30 millisecond pulses at a recurrence rate of 0.6 per second. The receiver bandwidth is 30 cps, and appropriate arrangements have to be made to allow for the Doppler shift in the frequency of the returned signal. The most important results obtained with this apparatus concern the long-period fading (20 to 30 minutes), which by cross-polarization experiments has been shown to be due to the rotation of the plane of polarization of the radio wave as it traverses the ionosphere (the Faraday effect). This immediately led to the development of a moon echo system by which the total electron content of the ionosphere could be determined.

The magneto-ionic theory shows that the polarization shift depends on the total electron content of the ionosphere per square centimeter along the line of sight. Experiments on a single frequency can give only the rate of change of the electron content, and it is necessary to carry out the measurements on two closely spaced radio frequencies. Measurements of the total electron content by this means indicate that the electron content is considerably greater than that estimated on the basis of a simple parabolic region.

Telescope Removes Handicaps: The technical difficulties in this work are considerable, and with the present aerial system, measurements can be made only with the moon in transit for about 10 periods in each lunation. The new telescope will immediately remove these handicaps and will enable systematic data to be collected about the total ionospheric electron content. This is bound to be of considerable importance to our understanding of the ionosphere and of solar terrestrial relationships.

The problem of radio echoes from the planets is vastly more difficult, and, as far as is known at present, no serious attempts have yet been made to solve it. Success in detecting radio echoes from Venus would demand an over-all power sensitivity between a million and ten million times greater than that required in the case of the moon. This assumes, of course, that the reflection coefficient of the planet would not be inferior to that of the

(*Continued on page* 166)

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TV NEWS

New Silicon and Germanium TV Rectifiers

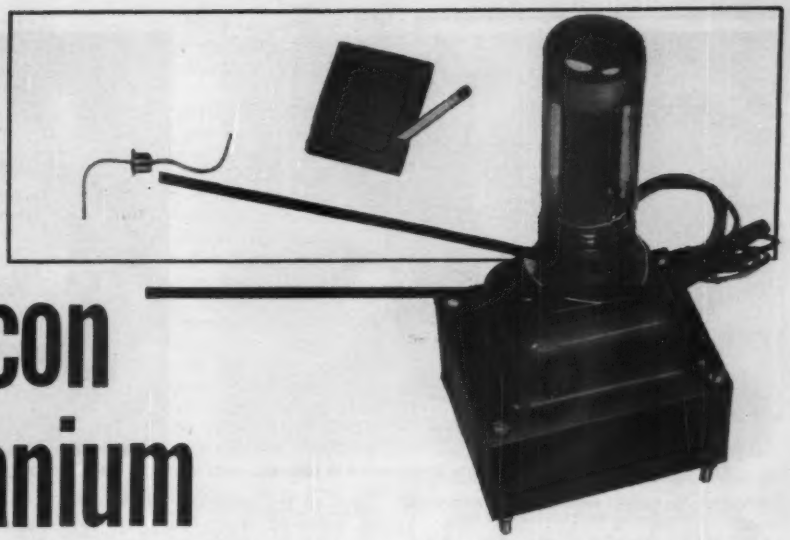


Fig. 1. The bulky combination of rectifier tube and power transformer, once the heart of the TV power supply, has given way to one or two semiconductor rectifiers, which may be as small as the Westinghouse silicon diode shown here. The match book indicates relative size.

Practical pointers on the semiconductors that continue to replace tubes in TV power supplies.

ALREADY widely specified for military and commercial applications, germanium and silicon rectifiers are now available at reasonable prices for use in TV receivers. As a matter of fact, some recent receivers are using these diodes as original equipment in their power supplies.

While these devices are too new for their ultimate value to be assessed, they show some interesting promise with respect to stability, temperature, and efficiency as compared to more conventional rectifiers used in the power supplies of TV receivers.

On the basis of size alone, the obvious and dramatic improvement in rectification efficiency which is possible today can be seen in Fig. 1. The heart of the TV power supply originally was the power transformer and the vacuum-tube rectifier, such as the 5U4 which is shown. It is now possible to supplant these elements with two silicon diodes similar to the one shown in Fig. 1.

Aside from size, silicon diodes are particularly advantageous in installations generating high ambient temperatures. Such diodes operate, without derating, up to 125° C. with currents up to several amperes. Germanium rectifiers have lower operating temperatures, but also exhibit the rectification efficiency and "non-aging" characteristics which make both types of rectifiers attractive for TV application.

Semiconductor Rectification

Operation of a vacuum-tube diode is a familiar phenomenon. Semiconductors rectify because they are devices or materials through which current can flow in only one direction, essentially. In the case of a selenium rectifier, rectification occurs at the junction between the selenium and its base. The selenium coating over the steel plates is usually quite thin, and the amount of current a rectifier can safely carry depends upon the area of the plates. Inherently, selenium rectifiers are suitable only for low-voltage applications; in order to use them for 117-volt circuits, several plates, usually five or six, are connected in series. Selenium rectifiers have low resistance in one direction and a relatively high resistance in the other direction.

Editors Note: A check with TV set manufacturers shows that, among those using semiconductor rectifiers in their power supplies in place of vacuum tubes, there is no marked trend to indicate that one type of semiconductor material will supplant the others in the near future. While some manufacturers have begun to use silicon or germanium rectifiers, others continue to prefer selenium. With development and improvement going relentlessly forward in all three materials, it is impossible to say whether any one of these three types will eventually show sufficient superiority over the others, in terms of either reliability or economics, to be used almost exclusively; nor is it presently possible to predict which that type may be. However, while the technician has had many years during which to become familiar with selenium rectifiers, those made of silicon and germanium are still new and unfamiliar. Therefore, since they are being encountered with increasing frequency, either as original equipment in receivers or when they are offered as replacements for other types, it is good sense to become familiar with them and their potential now.

In most TV circuits, their polarity is so arranged that they pass the positive portion of a sine wave and stop the negative. Silicon and germanium rectifiers get their rectification properties from the junction of the base metal with some impurity. In silicon diodes, this impurity is usually a small drop of indium or gold antimony. For germanium diodes, indium or some aluminum derivative is used to produce the desired impurity. Rectification takes place only at the junction point because electrons there can move only in one direction.

The amount of current and the maximum allowable peak inverse voltage in a germanium or silicon rectifier depends on the internal construction and on the amount of heat that can be conducted away from the junction itself. Compared to the selenium rectifier and to a vacuum tube, the "forward" resistance of these new diodes is much less and the backward or "reverse" resistance is much greater. For this reason, there is much less power lost in the rectifier during the period when current passes. There is also much less leakage current during the non-conductive cycle and, therefore, much less heat generated at the junction. These are the basic characteristics that produce the increase in rectification efficiency.

The construction of silicon and germanium diodes is practically identical. Both types of rectifiers consist of small pieces of the semiconductor material mounted in a hermetically sealed metal capsule. A typical construction technique is shown in Fig. 4. The silicon wafer is welded to a copper piece which connects to the case, while the "plate" connection from the antimony dot goes

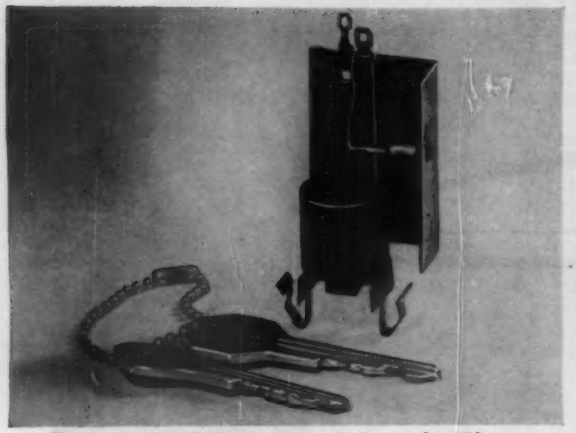


Fig. 2. The G-E 1N573 germanium diode, rated to 250 ma.

Fig. 3. The International Rectifier's silicon "Unistac."

through a glass seal to an external lead.

Note the fact that the case corresponds to the cathode of a vacuum tube. The hermetic seal and welded construction are necessary to prevent contamination of the semiconductor material. The large metal area corresponding to the cathode side of the rectifier is the portion that dissipates most of the heat. In the replacement units shown in Figs. 2 and 3, the metal shell mounts directly on a larger metal plate intended to dissipate the heat.

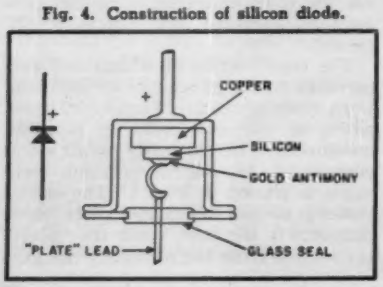
Actually, the amount of heat generated in a typical silicon diode used for TV power supplies is not great enough to require special mounting or radiating fins. In the replacement units shown, the mounting was adopted mostly to facilitate replacement of standard-mount rectifiers. Many of the new receivers now appearing on the market use silicon diodes as an integral part of the power supply, and these units appear as in the photograph of Fig. 5, without any special heat-radiating fins. A typical example is the unit which, in the mounting shown in Fig. 3, can pass up to 500 ma. and, in the much smaller case shown in Fig. 5, can operate at 250 ma.

Typical Germanium Units

General Electric has recently published a replacement guide which enables the service technician to substitute a new germanium rectifier for almost all rectifier stacks found in receiver models dating back to 1953. This unit has been designed with heat-dissipating plates and terminal lugs to fit into the same place and mounting as most of the selenium units it replaces. A total of seven different types are actually available, but only three types will be suitable for replacement. Four of the new germanium types are intended for new-equipment design and have special mounting features for printed circuitry. The type 1N573, shown in Fig. 2, is a half-wave rectifier intended to operate from the 117-volt line and designed for 250 ma. output. The 1N575 can carry 350 ma. The third model, 1N581, is a 250-ma. doubler and takes the place of two selenium rectifiers, or a full-wave stack.

Like their selenium counterparts, these diodes have a very low forward resistance and must, therefore, have a series resistor of 4 or 5 ohms, to limit current. In a typical voltage-doubler circuit, such as shown in Fig. 7, the average voltage drop across each diode is only .12 volt with an output current of 250 ma. These rectifiers can operate up to 120°F and, their manufacturer believes, will not show any sign of aging for the life of the TV receiver. Exact life expectancies of germanium rectifiers are not yet available, but, from tests conducted so far, it would appear that more than ten years of undiminished power output may be expected from the average unit.

Fig. 4. Construction of silicon diode.



Typical Silicon Rectifiers

Fig. 3 shows some typical silicon rectifiers, made by *International Rectifier Corporation*, specifically designed to be used as a direct replacement for existing selenium rectifiers. Each of these units is represented as being equivalent to a selenium rectifier capable of carrying 500 ma. and, like the selenium units they replace, the silicon diodes are used with a series resistor, usually 5 ohms. The advantages of the silicon unit are reported to be somewhat higher "B+" voltage, cooler operation, and long life without any aging.

While the "Unistac" 500 was designed specifically as replacement for existing selenium rectifiers, other silicon diodes are available without the heat-radiating fins, to replace rectifier tubes in equipment using power transformers. Of particular interest to the service technician are those silicon units which are mounted on tube sockets for direct plug-in replacement of many popular vacuum-tube rectifiers. A typical example is the S6X4, shown in Fig. 6, which can be plugged in to replace the 6X4 vacuum-tube rectifier shown with it. Another similar plug-in replacement for the 6X4 is the TI/680, made by *Texas Instruments*. The new "B+" circuit is illustrated in Fig. 8. In addition to the obvious saving of filament power and subsequent heat, the S6X4 also has only a six-volt drop at 70 ma. as compared to 22 volts for its tube equivalent with this current. Note that the impedance of the transformer itself serves as the limiting resistor in Fig. 8.

International Rectifier Corporation is preparing to release other plug-in units, such as the S6W5 and S5R4GY. *Sarkes Tarzian Incorporated* offers a series of full-wave silicon replacement rectifiers which can be used as substitutes for practically any tube rectifier. A typical comparison of rectifier efficiency between the popular 5U4 and the S5018 silicon replacement shows that, while the vacuum tube itself dissipates 42.6 watts in a typical circuit, its silicon replacement dissipates less than 1.5 watts. The reduction in dissipation means that the silicon unit itself will be much cooler and contribute substantially less heat to the entire chassis. Cooler operation will prolong the life of other components as well. In addition, the silicon replacement is not subject to the problems of vibration, emission, and filament-voltage variation.

Replacing Tube Rectifiers

From what has been said so far, one might jump to the conclusion that, certainly as far as vacuum-tube rectifiers are concerned, one should go right ahead with a semiconductor replacement on any set that comes in for repair. There are, nevertheless, some very real limitations.

On the matter of price alone it may be impractical to make a replacement for a tube. On the one hand, such units as the "Unistac" 500 retail at about $1.50 and germanium rectifiers, like

the *G-E* types shown in Fig. 2, also compare in price to selenium equivalents On the other hand, rectifiers specifically designed to replace vacuum tubes run considerably higher. The S6X4, to illustrate, is quoted as costing about $20!

Why so great a difference? Units like the "Unistac" 500 are rated at 117-volt r.m.s. input and are thus entirely suitable for use where there is no transformer step-up of the line voltage before it is applied to the rectifier. Each of the two silicon diodes built into the S6X4 assembly, however, is rated at 400 volts r.m.s. input and a maximum peak inverse voltage of 1250 volts.

Another consideration when silicon diodes are contemplated for use in place of vacuum tubes is the smaller voltage drop across the silicon diodes themselves, with the resultant increase of available "B+" voltage. While this may seem highly desirable in some cases, it can also create problems. In the case where a 5U4 rectifier is replaced, for example, an additional 45 volts of "B+" may be available. If "B+" was originally 325 volts, it will thus rise to 370 volts. However, in many power supplies, the filter capacitors are rated fairly close to the actual operating voltage intended. Conditions of high line voltage and frequent surges may result in "B+" voltages which approach or exceed the working-voltage rating of the filter capacitors, if "B+" is increased. In our example, the filter capacitors may have been rated at 400 working volts d.c. At the instant the receiver is turned on, the diodes will provide "B+" even though the various tubes in the set have not yet warmed up and, therefore, do not draw any power. This means that the voltage at the filter capacitors will be higher than under full-load conditions. Even though this warm-up surge may last only a few seconds, repeated excess voltage will ruin the capacitors within a relatively short time. Sustained operation at 370 volts and surges up to 400 volts or more would require capacitors rated for, at least, 450 working volts d.c. It is usually not worthwhile to replace a 5U4 rectifier and, *in addition*, replace the filter capacitors. For this reason it may not always be practical to install a substitute in a particular TV receiver.

A good rule appears to be that, if the filter capacitors are rated more than 85 volts above the original "B+" working voltage, a semiconductor substitute would work out. While it is feasible to use a bleeder resistor to reduce the surge voltage, the resulting power loss in the resistor and the heat thus generated do not make this advisable.

The series resistor used with these rectifiers limits the amount of current that can be drawn through the rectifier and tends to keep sudden surges to a minimum. If a short circuit occurs in the "B+" system of a TV receiver using silicon or germanium rectifiers, it is possible to burn out the rectifier in the same manner as a selenium unit or vacuum tube may be burned out. A fuse or fusible resistor will protect the rectifier in such instances. Whenever a silicon or germanium rectifier is installed, the technician should check the circuit to see whether a fuse of some kind is used. It is not very difficult or expensive to add a fuse to almost any existing TV receiver and, if the customer is advised of its advantages, the small extra charge will not be resented.

Test Procedures

The simplest check for a defect in a "B+" circuit using a silicon or germanium rectifier would seem to be an ohmmeter test. While such a test will indicate polarity and show up most burned-out rectifiers, it is not a valid way to measure forward and reverse resistance. The reason for this is that the voltage applied through the ohmmeter will affect the apparent resistance because of the nonlinear diode characteristic. A much better test uses a battery, a potentiometer, and a milliammeter. With the positive battery terminal connected to the "plate" side of the diode, connect the body or "cathode" to the potentiometer and milliammeter as shown in Fig. 9. Adjust the potentiometer to read about 10 ma. If the battery is reversed, no current should be measured.

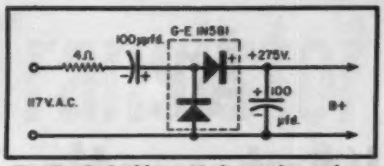


Fig. 7. A doubler with low voltage drop using the G-E 1N581 germanium rectifier.

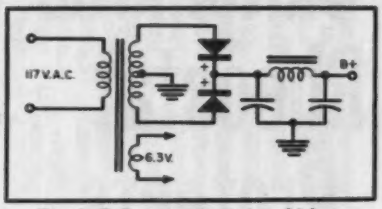


Fig. 8. Full-wave circuit in which a T1/680 or S6X4 replaces a 6X4 tube.

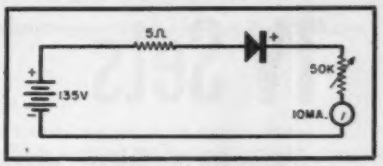


Fig. 9. Semiconductor test set-up.

More elaborate tests on silicon and germanium diodes are usually not needed in ordinary service work, but there are now special diode testers on the market which can give a more accurate indication of the diode characteristics.

Other Uses

Silicon and germanium rectifiers will make their appearance in AM and FM radios as well as in the control circuits of some new household appliances. Their application as high-voltage rectifiers in TV receivers has been predicted, but, at the time of writing, no inexpensive, reliable rectifier of this type has been announced. In military equipment, high-voltage rectifiers using silicon elements are just now coming into use where reliability, ruggedness, and rectification efficiency are important. The relatively high cost of this type of rectifier makes its application to consumer products doubtful at this time. —30—

Fig. 5. The diode of Fig. 3 used without a heat radiator.

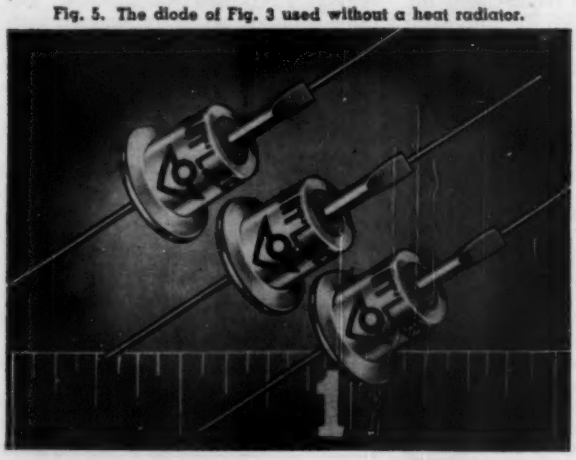
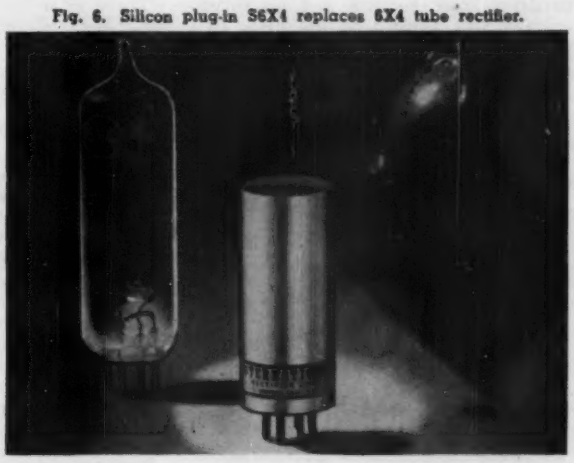


Fig. 6. Silicon plug-in S6X4 replaces 6X4 tube rectifier.



An "Automatic Rheostat" Protects TV Sets

By
LUTHER A. GOTWALD, Jr.

Fig. 1. The completed unit may be mounted inside the receiver cabinet.

Adding a 3-step, thermal-delay device protects the TV receiver by providing gradual warm-up.

BY ATTACHING an "automatic rheostat" to the power input of a TV receiver or other electronic equipment, the entire circuit can be protected from surge currents and voltages when the equipment is turned on. Containing only six electronic components—three thermal-delay relays and three resistors—the simple circuit described here indeed acts as an automatic rheostat, protecting tubes, electrolytic capacitors, and rectifiers from damaging surges.

Two years ago the author repaired an eight-year-old TV set. After replacing nearly all the filter capacitors, it was decided to protect them with a time-delay relay. A 30-second delay relay was applied to the power transformer while a separate filament transformer pre-heated the cathodes of the tubes. When the power supply cut in 30 seconds later, the tubes were ready to draw their current and no surge voltage was applied to the filter capacitors. Not one capacitor failure occurred during the next two years. However, a service record shows that there was one defect. The surge of current going through the power supply burned out a rectifier tube at the rate of one every four months.

Fig. 2. Mounting of resistors and sockets on cake pan before the pan is cut.

More recently, another, similar protective device was added to a new receiver to correct the failing of the former circuit. The series connection of filaments and the use of selenium rectifiers in the power supply suggested, as a solution, a stepped variable input of voltages from about 30 volts to 117. Four voltage steps were achieved by using three time-delay relays which close switches at 10-second intervals, each in its turn shorting out one of the three resistors in series with the TV set. When the set is turned on, the resistance in series with the a.c. input goes through an automatic cycle of 325, 175, 25, and 0 ohms.

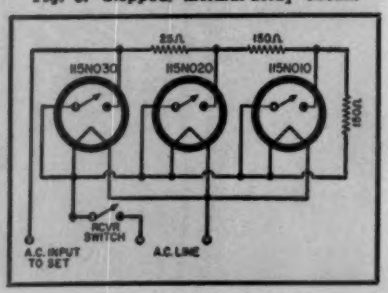
There is no special requirement for the chassis pan on which the automatic warm-up control is built. The author used an ordinary aluminum cake pan, 8" by 8" by 2", with excess being cut away just before the finished unit was mounted in the receiver, as shown in Fig. 1. Mounting of the octal sockets and the resistors on that portion of the cake pan which was used is shown in Fig. 2. The circuit is shown in Fig. 3. The three *Amperite* thermal-delay relays, types 115N010, 115N020, and 115-N030, are designed to close respectively after 10, 20, and 30 seconds from the time power is applied to them. All are made in conventional vacuum-tube envelopes with octal bases and all use 115-volt heaters so that they may be placed directly across the line. Each draws only 2 watts and is designed so that heater power may be continuously applied. As a result, the extra power all three relays consume while the receiver is in operation is not significant.

The delay relays are connected directly to one side of the power line; but through the receiver's "on-off" switch. One wire on the a.c. input of the receiver—the one connected to the "on-off" switch—is lifted from its existing connection and connected instead to the 115N030, last of the relays to close, as shown in Fig. 3. One side of each of the three relay switches is then connected to the wire going to the set's "on-off" switch.

Now the three resistors, each a wire-wound unit rated at 20 watts, are connected in series, beginning with the 25-ohm unit. The unconnected end of the 25-ohm resistor is then connected to the unswitched pole on the 115N030. Connection is then made between the junction of this resistor with the first 150-ohm resistor and the free pole on the 115N020. Then the junction between the two 150-ohm resistors is connected to the free pole on the 115N-010. The free end of the final 150-ohm resistor is returned to the switch. The three resistors act in conjunction with the internal resistance of the receiver, when the switch is turned on, as a voltage divider, reducing the input voltage to the set.

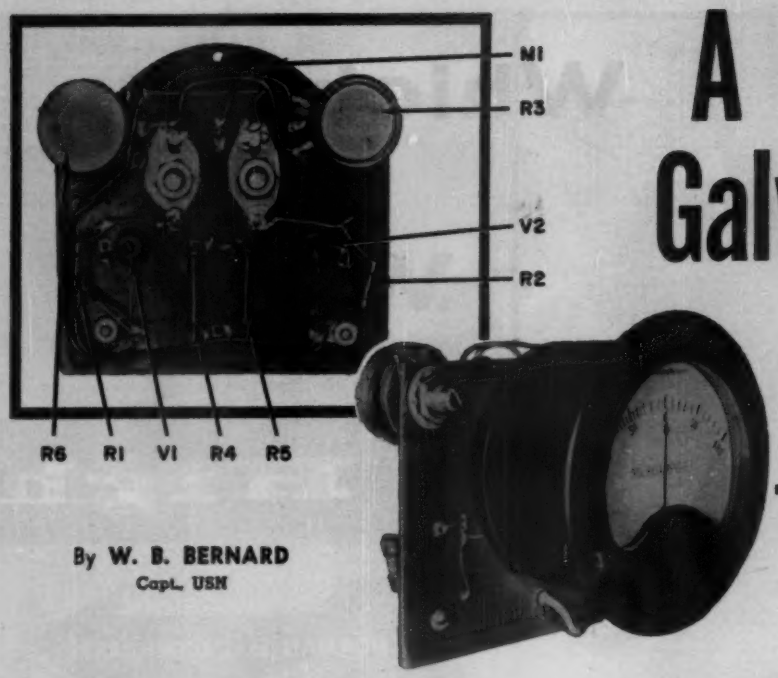
(*Continued on page* 161)

Fig. 3. Stepped, thermal-delay circuit.



A Transistor Galvanometer Amplifier

By W. B. BERNARD
Capt., USN



Front and rear views of galvanometer amplifier showing the components used.

Ultra-sensitive unit gives full-scale meter deflection with an input signal of 2.5 to 3 μa.

AN EXTREMELY sensitive galvanometer is a very useful device around the laboratory or shop, however, it is quite expensive and delicate. For some applications we may substitute for it a less sensitive galvanometer driven by an electron-tube amplifier. Such a system will work very well where the signal source has a high impedance which may easily be matched by the input impedance of the electron-tube amplifier.

There are other cases where the input signal is furnished from a low-voltage, low-impedance source. In such a case the gain of the amplifier may not be great enough to compensate for loss due to the impedance mismatch at the input of the system.

In the past a high sensitivity galvanometer was the only solution to such a problem but now the transistor is available to help out. It is a current amplifier and because it has a very low input impedance it requires very little input voltage. Because its input impedance is of the same order as that of the galvanometer movement, it will offer a considerable current gain irrespective of the impedance of the signal source.

The amplifier shown in the schematic will give full-scale deflection of a 100 μa. meter with an input signal of 2.5 to 3 μa. depending on the value of the collector voltage supply.

The amplifier consists of two 2N107 transistors connected in a push-pull grounded emitter circuit. The input signal is connected between the bases of the two transistors and the output signal is taken from the collectors. The 50-ohm emitter resistors and the 330,000-ohm resistors connected from the collectors to the bases serve to stabilize the transistor characteristics.

Since the transistor bases draw current it is necessary to have two balance controls to maintain balance under all conditions of the input circuit. The 10,000-ohm potentiometer in the collector circuit is adjusted to give a zero meter reading with the bases shorted together and the 250,000-ohm potentiometer is adjusted to give a zero reading with the short circuit removed. The first time these zero adjustments are made it may be necessary to go through this sequence twice.

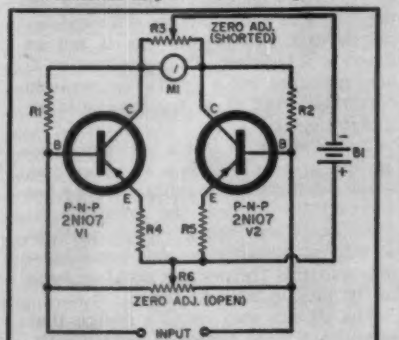
These adjustments insure that when there is no external applied signal all base current is being supplied by the biasing circuit. Under these conditions the zero setting is unaffected by variations in the impedance of the signal source and the transistor amplifier will furnish no current to the external circuit.

The photographs above show the physical construction of the amplifier. It is built on a 3" to 4" card of insulating material which mounts directly on the terminals of the 100-0-100 μa. meter that is driven by the amplifier. No attempt was made to compress the circuit to a minimum size. Except for the space occupied by the two zero-setting potentiometers the size of the unit could be reduced by a factor of two or three.

Power for the collector supply may be taken from dry cells. If maximum sensitivity and linearity are not required a single cell will be sufficient. With a 1.5 volt supply it requires an input of 3 μa. to cause full-scale deflection of the meter. If the supply voltage is increased to 6 volts, full-scale deflection is achieved by an input current of less than 2.5 μa. Even with a 6 volt supply the total current drain from the supply is less than 1 milliampere so that the life of the battery should be about equal to the shelf life.

The present amplifier was not designed with an object of providing absolute accuracy, however, tests so far indicate that its characteristics are sufficiently stable to permit its use as a basis for a voltmeter with a sensitivity of 400,000 ohms-per-volt. Such a unit would give most of the advantages of a v.t.v.m. without requiring an a.c. power connection or an expensive load of batteries. —30—

Schematic of galvanometer amplifier.



R1, R2—330,000 ohm, ½ w. res.
R3—10,000 ohm pot
R4, R5—50 ohm, ½ w. res.
R6—250,000 ohm pot
M1—100-0-100 μa. meter
B1—1.5 to 6 volt battery (see text)
V1, V2—"p-n-p" transistor (2N107)

Which Way To High

By NORMAN H. CROWHURST

Should I buy now or wait? Shall it be a packaged system or one using components? Here are the answers.

THE prospective buyer of a high-fidelity system is invariably concerned with the question, "Will they be better next year—or the year after? Should I buy now or wait?" This really hinges on a more basic question, as to how much better high-fidelity reproduction can get—is there an ultimate in high-fidelity and have we almost reached it?

Starting to investigate, related questions arise, such as: Which is the best arrangement, a packaged system, bought all in one unit, or a component system, where we go and buy separate pickup, turntable, tuner, preamplifier, amplifier, and loudspeaker system? Then, whichever of these systems we buy, what should we look for in each section? Where can we expect to find further improvement in performance and to what extent? A straightforward answer to these questions will be of assistance to the prospective high-fidelity buyer in answering the first one, as to how much improvement he is likely to see in "next year's model."

Pickup-Tone Arm

Taking phonograph reproducers first, we will start with the pickup-tone arm combination. The earliest of these, many years ago, came as an integrated unit. The pickup was inseparably part of the tone arm. Then, in the interest of versatility and to provide for ready replacement of the expendable part, the plug-in cartridge was adopted. Not only could a new cartridge of the same type be installed into the original arm, but the user could go out and buy another type of cartridge.

The great advantage of this system is that it enables the user to change to a better type of cartridge when it appears. Also arms and pickups can be chosen separately. These advantages have been largely responsible for maintaining the popularity of the interchangeable plug-in arrangement for these many years. Now some manufacturers are reverting to an integrated pickup and tone arm.

The expendable part, the stylus and its assembly, is usually replaceable or interchangeable. This makes the unit readily adaptable to both 3 mil and 1 mil grooves and also makes the expendable part replaceable. But the mounting is unique for the particular pickup and tone arm assembly so it is not possible to put one manufacturer's pickup on another's tone arm. They each come with their own complementary parts.

This development has come about, because, as pickups near perfection, it becomes evident that the two do complement one another. One cannot design a pickup with perfect performance without considering the arm it operates in—or *vice versa*. But, of course, this loses the advantage of versatility.

Phono Preamplifier

Electrically, the pickup has to feed correctly into the preamplifier so as to give sufficient output, without overloading and causing distortion. Preamplifier manufacturers encountered the problem of how to adjust the gain of their units so as to readily accept pickups having different output levels.

If the preamplifier is made sufficiently sensitive to accommodate the pickups with very low output, such as some of the earlier moving coils, then it is liable to produce some distortion in the earlier stages when connected to a pickup with considerably larger output.

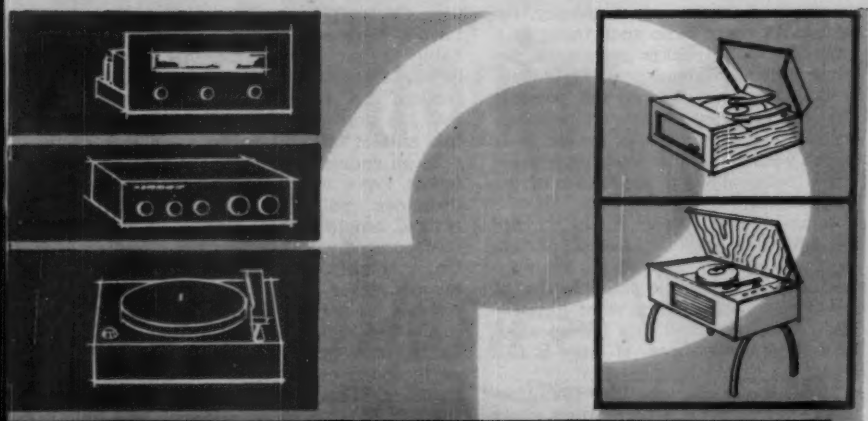
Of course, if the pickup is a ceramic or crystal, instead of magnetic or moving coil, a completely different input is used anyway so this is not so much of a problem. The equalization is also different for a crystal or ceramic cartridge than it is for magnetic or moving coil.

The problem of levels between pickup and preamplifier is a two-way one. Some preamplifier manufacturers have successfully solved the problem so their units will operate from pickups of varying sensitivity—but some have not, and this throws the problem back to the pickup manufacturers.

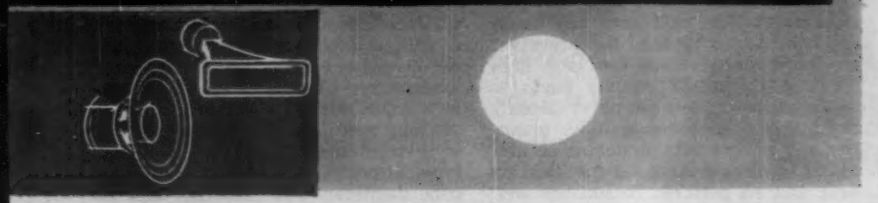
The pickup may be of a design that provides a wide choice of output voltage. It could be made to give quite a good output and thus give better possibilities of avoiding hum and noise pickup. This would yield an effectively greater dynamic range from the unit.

The deterrent to using the best possible output voltage is that the sensitivity is higher and, consequently, with *some* preamplifiers overload may be produced in the earlier stages. It is true this overload is not strictly due to the pickup. The same pickup connected to a preamplifier with proper provision for different levels from the pickup would sound perfect. But, connected to a preamplifier designed primarily for the low sensitivity pickups, overload occurs. Then a comparison, for example, between the older moving coil types with low sensitivity and the new high-sensitivity magnetic, can give the false impression that the newer cartridge produces distortion, when it is really produced in the preamplifier due to the higher level.

With this kind of situation the manufacturer not only has to make sure *his* unit performs according to specification, but he has to guard against possible wrong conclusions that may be drawn by the user from distortion elsewhere in the system. This kind of problem recurs frequently at different points throughout the high-fidelity system and is a particular headache to component manufacturers. It *could* be regarded as a disadvantage of the component approach. But anyone who is seeking to better his system, by getting improved components as they become available, considers that the advantages of the component approach



Fidelity?



in this respect outweigh this particular disadvantage.

Turntable or Record Changer?

This, too, is an old question and has been discussed several times before. The present trend seems to be toward the use of a simple turntable for playing LP's (and probably 78's as well in some instances, for those having an extensive library of 78 discs). The 45's were created for a basically different purpose. Their intent is to provide a continuous program, for background music, dancing, or such occasions. This being the case, the type of low-cost changer designed for them seems best suited for the purpose.

The sensible approach seems to be to use a good turntable for 33 LP's and a separate low-cost changer for 45's. Some of the modern multi-speed turntables do a very good job of producing uniform performance on all speeds but, in general, it is usually possible to get better performances using the simplicity of drive that can be employed for a single-speed turntable.

The latest announcement in this direction is of an electronically driven turntable. The 60-cycle line will drive this turntable at 33 as a single-speed turntable. Then an additional unit with a four-way switched oscillator provides the necessary frequencies to drive the same turntable at 16, 33, 45, and 78, with a range of adjustment on each speed. This approach seems to show promise of combining the advantage of mechanical simplicity in a single-speed drive with multi-speed operation.

However, if you are budget minded, you will probably find a single-speed drive at lower cost that will give performance indistinguishable from this new development for most purposes. There are several good products on the turntable market that will give really good performance for some time.

Radio

The important thing to look for in a radio receiver, whether it comes as a high-fidelity receiver complete with power amplifier and loudspeaker system, or whether you are buying a separate tuner, is that the receiver section should be suitable for the locality in which it will be used. This is true for both AM and FM reception.

At one time, in answer to the question whether one should buy two separate tuners for AM and FM, or a combined changeover type, the preference would definitely have gone to the two separate units, provided you could afford it. The only excuse for taking a combined unit would have been on the score of cost. But modern engineering technique has certainly produced some very good combined units, so it is not possible to generalize any more. The choice must be made on the performance of the individual components.

In these days when more and more man-made equipment is producing interference all over the band, an important feature is the standard of interference rejection achieved by the receiving units. Interference can come in either through the antenna or through the power line.

Rejection of interference coming in through the power line can be achieved by an appropriate type of interference rejector connected between the supply outlet and the line cord. This keeps the interference well away from the receiver itself.

The kind of interference that comes in through the antenna is usually of the short-duration, high-energy-level type, the duration of the impulse being only a matter of microseconds and the energy level many times that of the received signal.

Without interference suppression such an impulse will close the set down, possibly for a period of almost a second after each impulse. If the impulses are fairly close together—two or three to the second or more—it can completely interrupt reception.

The first stage of interference rejection consists of bypassing these impulses early in the r.f. section of the receiver, so as to prevent them being passed on through the rest of the amplifier and causing overload-blocking.

This step certainly reduces the blocking effect of the impulses, but they can still be quite *audible* because the little bit of impulse before the bypass effect comes into operation still gets amplified. The audio amplifier "spreads" it so as to be audible as a plop or scratch from the loudspeaker. Interference of this type can still mar the reproduction considerably by a rapid succession of plops and scratches.

More modern types of interference suppressors employ extra tubes and delay networks to block off amplification for the duration of the impulse and at the same time "hold" the audio waveform while this blocking off takes place. This may be regarded as a three-stage suppressor and this kind of suppressor is now available on a good many AM tuners. It may be regarded as a "must" for high-fidelity.

Of course, it is important to select a tuner with a suitable bandwidth for the degree of sensitivity and selectivity necessary in your location. If you are fairly close to a few powerful transmitters and these are the only ones you wish to receive, a wide-band tuner without too much selectivity or sensitivity will give you higher fidelity reception than the more sensitive, selective ones made for distant reception.

In the latter case a greater selectivity and possible restriction of the bandwidth is necessary to avoid interference between channels. If you are a "bug" who wants distance as well as local reception, you need a receiver with a local/distant switch, which must be well-engineered.

In FM a similar principle is true. The sensitivity of the receiver should suit your locality. If you are very close to the transmitters you intend to listen to, there is no point in having a high sensitivity receiver that may only succeed in picking up more noise or interference. If the tuner comes with a two-way arrangement for adjusting for local or distant reception, this may well serve the same purpose.

In FM reception, as with other realms of high-fidelity, trends are evident. In the pickup field, at one time magnetic was the only type of pickup used. Then came the moving coil and crystal. Finally, with improved design we got back to the magnetic as seeming to give the best consistent degree of performance (although many still prefer the moving coil). But the possibility that a new design of ceramic will one day out-perform either should not be overlooked.

Similarly in FM reception, at one time the ratio detector achieved a degree of popularity, while for some time now the limiter/discriminator arrangement has been preferred as the better type. However, recent developments in the ratio detector, with an improved approach to the design, achieve results at least as good and possibly a little better. So the trend will probably swing back toward an improved ratio detector in the near future.

Always be on guard against the sweeping claim that a certain type of circuit is *inherently* better than some other type of circuit. This kind of statement should always be accepted with some reserve. Even if it is true at the time it is made, it would always be safer to add "at the present stage of development." Further development may always reverse the order.

Unfortunately, in the high-fidelity business, a large number of "engineers" become "wedded" to a particular circuit in a quite unscientific way. They are convinced that a certain circuit is best and there is no point in trying another circuit because they just know it isn't as good. *This attitude is certainly a hindrance to progress.*

The Power End

Under this heading we consider the amplifier and loudspeaker, which bring another set of problems. Amplifiers are *primarily* designed to meet a specification—to give a certain maximum power output with an adequately low amount of distortion and to achieve a certain linearity of frequency response. As there is no such thing as a "standard" loudspeaker impedance, because individual loudspeakers deviate in impedance in the widest possible way, the only way to specify performance of an amplifier is when it is loaded with a standard *resistance* value equal to the *nominal* impedance of the loudspeaker.

Some, from this fact, have accused the amplifier manufacturer of designing his amplifier to feed a resistance load and adopting the attitude that it is not his responsibility what happens when it is connected to a loudspeaker. In very few instances—*if any*—is this true.

Most, if not all, amplifier manufacturers have made a conscientious effort to see that their amplifiers perform at least reasonably well into the average loudspeaker. Due to the wide variation of possible loudspeaker impedances, it becomes almost impossible to guarantee that the amplifier will perform *uniformly well* into any loudspeaker. Added to this, the prevalent stress on performances to a very high specification into a dummy load (to which unfortunately we never listen!) has rather forced the amplifier manufacturer's hand, into producing an amplifier to meet a fantastic specification first and to perform reasonably well into most loudspeakers that may be connected to it second.

The loudspeaker manufacturer has been faced with similar problems. If one particular amplifier does not perform properly when his particular loudspeaker is connected to it, sometimes his loudspeaker undeservedly gets the blame.

An example of this situation is illustrated by one electrostatic tweeter manufacturer who has incorporated networks into his tweeter for the purpose of avoiding the distortion produced in some amplifiers when the combined impedance of the woofer and tweeter, producing resonance, causes a widely diverse loading on the amplifier.

Strictly, of course, this is none of the electrostatic tweeter manufacturer's business. But his tweeter is liable to get blamed for this misbehavior anyway, so for his own "protection" he incorporates a network into his unit that will guard against this kind of misbehavior.

In an endeavor to accommodate different types of loudspeakers, so performance will be more uniform, several amplifier manufacturers have incorporated variable damping circuits. Unfortunately this is not the whole answer either. Most variable damping circuits, as well as varying the damping in the region of loudspeaker resonance, also vary the stability margin or feedback criterion of the amplifier in other regions. The performance of the amplifier may be uniform *into a resistance load* throughout the range of the damping control, but it may not be uniform when connected to a loudspeaker.

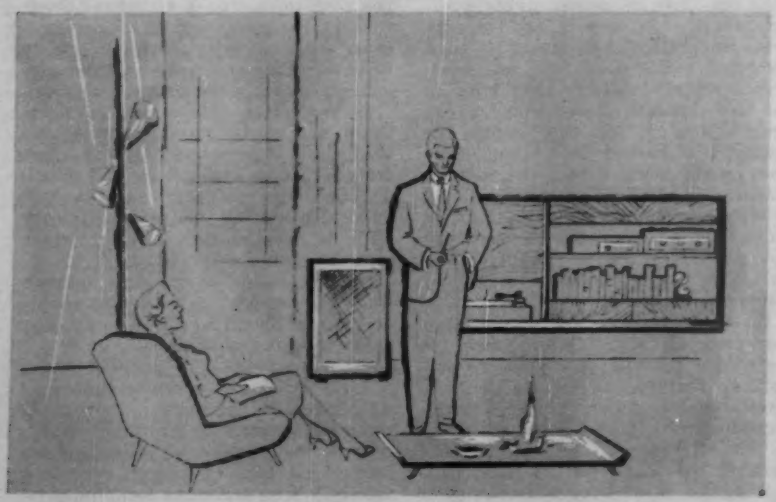
On the acoustic side of the loudspeaker, it has to be integrated with its enclosure and the room in which it will be used, as well as being correctly matched to the amplifier. A loudspeaker unit designed to operate in a small enclosure for acoustic suspension operation will not serve well in a large enclosure of the bass-reflex type, although it may have the right cone diameter. The fact that one 15-inch woofer works well in a bass-reflex enclosure of certain dimensions is not evidence that another 15-inch woofer can be interchanged in the same enclosure with identical results.

Then, as Mr. Brigg's article in the August issue shows, there is the matter of standing waves. These can be either exaggerated or minimized by the type of loudspeaker, its enclosure, and its position. To get the best performance we have to make a choice that virtually "integrates" the loudspeaker with the listening room.

Another question here concerns (*a*) the development of the wider range electrostatic loudspeakers, (*b*) the "servo" type loudspeaker, and (*c*) other possible developments with the component system. A difficulty with the wide-range electrostatic loudspeaker, even when this range only encompasses from somewhere in the region of 500 cycles up, is the poor possibility of achieving any degree of acoustic damping by electrical coupling to the amplifier. This is quite possible with dynamic type loudspeakers, as evidenced by recent developments that have been introduced along these lines.

However, it is not impossible that the electrostatic type unit can also be developed in this direction. A suggestion for this would be to develop a relatively simple negative-capacitance electronic circuit integrated with the electrostatic unit. This will cancel the electrical capacitance of the unit, enabling the basic power amplifier to be more directly coupled to the acoustic load on the electrostatic loudspeaker diaphragm.

(*Continued on page* 156)



An Electronic Photoflash

The completed photoflash unit that is described in the article below is shown here along with a snapshot that was taken with the aid of the unit. A pitcher of water was thrown into the air and the unit was flashed. The column of water from the pitcher appears to be suspended in mid air in the shot.

By **RICHARD GRAHAM**

Construction of compact unit producing a good flash with only 450 volts is either battery- or a.c. line-operated.

UP TO ABOUT five years ago, flash photography was an expensive proposition, particularly for the amateur with limited funds. Irrespective of whether the common flash bulb or the older type of high-voltage electronic flash was used, the cost was high. Both had inherent disadvantages which often outweighed the advantages, resulting in what might best be described as a subconscious reluctance on the part of the amateur enthusiast to accept either wholeheartedly.

Flash bulbs, of course, slowed up the picture taking by requiring changing after each exposure. In action photography this is a distinct disadvantage. It also required maintaining a stock of flash bulbs which had to be available for any photographic occasion which might arise.

With the advent of the electronic photoflash, speed light, or strobe light, call it what you will, these disadvantages were remedied. In fact, other advantages were soon apparent. The high speed of the flash could photographically stop or "freeze" any natural motion. The duration of the flash was about $\frac{1}{5000}$th of a second (the exact time depended on the power input and tube). This made the electronic flash a natural for high-speed action photography and wiggly things such as babies, animals, etc. Furthermore, the unit was good for over 10,000 flashes—which meant it probably would outlast the shutter with which it was used.

However, the high-voltage type of electronic photoflash had some serious drawbacks. The voltage required was in the neighborhood of 2000 to 4000 volts. Generally the power supplies used to supply this voltage were bulky because of the extra insulation required. Since most of the components used were special, the cost was high. It was not uncommon for one of these units to weigh 25 pounds.

Fortunately, subsequent developments have reduced the operating voltage to 450 volts, making the electronic photoflash a safe and practical reality. This relatively low voltage means that ordinary radio and TV components can be used with a consequent saving in size, weight, and cost. While this article will discuss the theory and design considerations of electronic photoflashes in general, a description of an economically constructed flash unit is also included which, because of its low cost, will appeal to all photo-electronic enthusiasts.

The basic concept of the electronic photoflash is simple. A d.c. power supply of some form is used to charge a large capacitor. This capacitor is then discharged through a special xenon-filled flash tube by means of a trigger circuit which is actuated by the camera shutter contacts.

The power supplies for charging the large capacitors used in the electronic photoflash have consisted of dry and wet batteries, vibrator supplies, a.c. transformer-type supplies, voltage doublers and triplers, or any combination of these. While all of these types of supplies have been used with success, the exact choice represents a compromise among three conflicting factors; namely, size, capacitor charging rate, and cost. The faster the capacitor charging rate, the heavier the current-carrying capacity of the supply, which usually means a large size. If a smaller supply is desired at the same capacity, then the cost will rise quite sharply.

It is felt a happy compromise has been reached in the unit described by using a voltage tripler with three 65 ma. selenium rectifiers to produce approximately 450 volts. The cost for this type supply is very low, its compactness can be verified from the photographs of the unit, and the capacitors can be brought up to charge within four or five seconds.

Electronic photoflash units are usually rated in watt-seconds. This refers to the energy storing capacity of the capacitors which is later discharged through the flash tube. The watt-seconds input can be calculated for any photoflash from the following formula:

$$W\text{-}S = \tfrac{1}{2}\, C\, E^2$$

where: C = capacity in microfarads

E = applied voltage in kilovolts.

Thus we can see that for a given watt-second input, the capacitor value will increase as the square of the voltage change. The higher the operating voltage, the less the capacity needed. However because of the danger involved with the high-voltage photoflash units a compromise can be found between the amount of capacity and voltage needed by operating in the 450-volt range.

Since high capacitance units in this voltage range are commonly used in TV and radio work, the cost of these capacitors is very low when compared to those in the higher voltage range. Furthermore, even though greater capacity is necessary with lower voltage to obtain an equivalent watt-second rating, the size is considerably reduced through the use of electrolytics. At voltages much higher than 450 or so,

The flash unit and the battery case that attaches to camera.

The power unit has a pilot lamp and delay adjustment on it.

electrolytic capacitors aren't too practical. Actually the cost for these capacitors can be reduced to 1¢ per microfarad or less by merely "shopping around" a bit.

There are a number of ways of triggering or causing the flash tube to conduct. The method used depends upon whether a high-pressure or low-pressure type of flash tube is used. The low-pressure, or self-ionizing, tube will flash when the high voltage is applied to its terminals. The usual and simplest way of accomplishing this is by means of a relay, as shown in Fig. 1.

Since the resistance of the flash tube is approximately 3 ohms when conducting, the instantaneous current through the tube and its associated circuit is on the order of 150 amperes (assuming an applied potential of 450 volts). Thus, because of the low resistances involved, any possible contact resistance should be avoided. Unless a special relay is used, that is, one designed specifically for this type of service, it is best to avoid firing by this method. However this method does have the advantage in that no high voltage exists in any external cable except for the very brief instant that the flash tube is fired.

The high-pressure type of flash tube is always connected across the high-voltage terminals and requires a high-voltage pulse (10,000-15,000 volts) to a grid wire on the flash tube to ionize the gas and start the conduction. This method eliminates the possibility of contact resistance in the discharge circuit. Many systems using the high-pressure type of flash tube utilize the discharge of a small capacitor in the .1-.5 μfd. range into a model airplane ignition coil to produce the high-voltage pulse. This capacitor is charged by means of a high-resistance voltage divider across the high voltage.

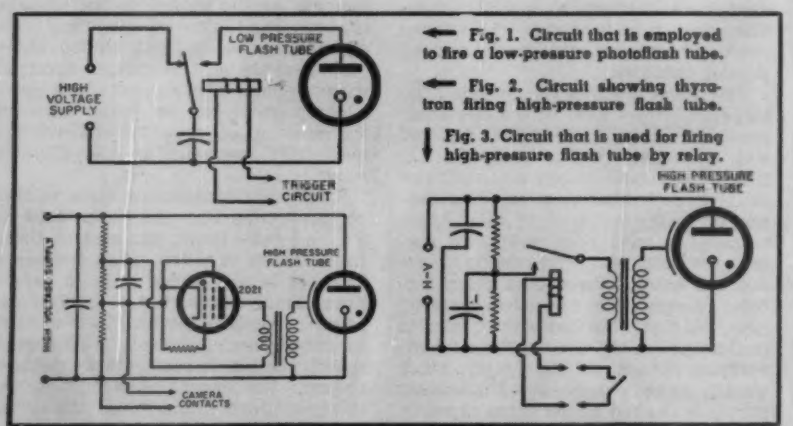
The discharge of the trigger circuit capacitor can be accomplished directly with the camera shutter contacts. However, to reduce the shutter contact current a more satisfactory method is to discharge the trigger capacitor by a relay or thyratron which, in turn, would be actuated by the shutter contacts. Either of these two methods provides a simple means of synchronizing the shutter opening with the flash. Many camera shutters are designed strictly for use with the usual magnesium flash bulb. These flash bulbs have a 5 to 20 millisecond delay between the time the voltage is applied to the lamp, *i.e.*, the shutter contacts have closed, and the time of maximum flash intensity. Since the delay of an electronic flash is practically zero, some provision must be made to delay the time between the shutter contact closing and the flash. This is done very easily in the thyratron or relay method by introducing an electrical delay with resistance and reactance.

A typical circuit for firing the flash tube by means of a thyratron is shown in Fig. 2. This method has the lowest camera contact current, about 1 ma., a very good advantage, however it also adds to the circuit complications.

The relay method represents a compromise between the use of a thyratron and the use of the camera shutter contacts to fire the flash tube. The relay current is small and the flash can be easily synchronized. Furthermore, there is nothing special about the relay. For these reasons, it was used in the model shown in the photographs. A typical circuit of the relay firing method is shown in Fig. 3.

The electronic flash outfit described consists of a basic power unit (Fig. 4A), and a flash unit (Fig. 4B) to which can be added, if desired, a booster unit (Fig. 4C) and a battery unit (Fig. 4D).

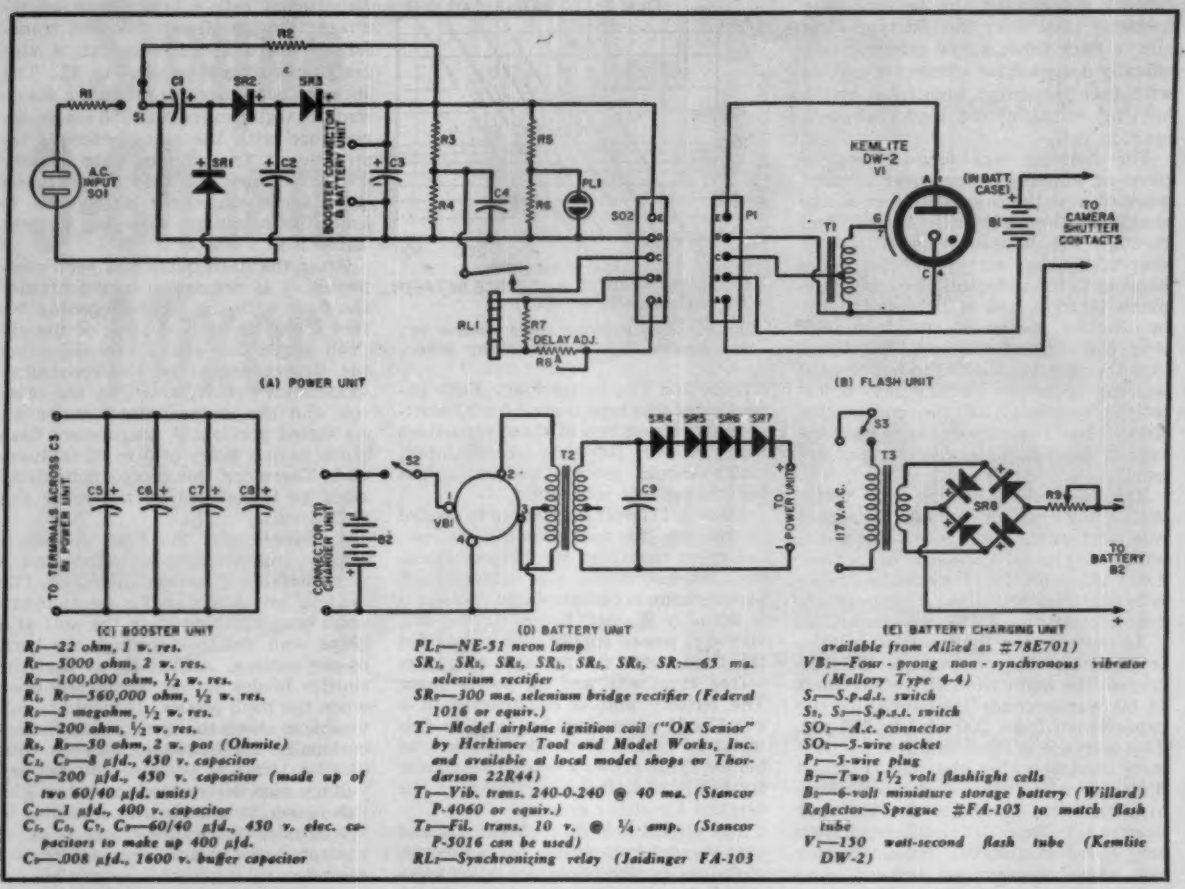
The basic power unit is built into a box 4"x6"x2" and, when used with the flash unit, makes up a complete flash outfit. This unit consists of a voltage tripler, 200 μfd. worth of capacitor, a capacitance charge indicator, and various parts of the trigger circuit. The voltage tripler produces approximately 450 volts which, in conjunction with the 200 μfd. capacitance, will give a 20 watt-second input to the flash tube. The capacitance charge indicator consists of the neon lamp PL_1 and resistors R_5 and R_6. The neon will light when



← Fig. 1. Circuit that is employed to fire a low-pressure photoflash tube.

← Fig. 2. Circuit showing thyratron firing high-pressure flash tube.

Fig. 3. Circuit that is used for firing high-pressure flash tube by relay.



R_1—22 ohm, 1 w. res.
R_2—3000 ohm, 2 w. res.
R_3—100,000 ohm, ½ w. res.
R_4, R_7—560,000 ohm, ½ w. res.
R_5—2 megohm, ½ w. res.
R_6—200 ohm, ½ w. res.
R_8, R_9—30 ohm, 2 w. pot (Ohmite)
C_1, C_2—8 µfd., 450 v. capacitor
C_3—200 µfd., 450 v. capacitor (made up of two 60/40 µfd. units)
C_4—.1 µfd., 400 v. capacitor
C_5, C_6, C_7, C_8—60/40 µfd., 450 v. elec. capacitors to make up 400 µfd.
C_9—.008 µfd., 1600 v. buffer capacitor
PL_1—NE-51 neon lamp
SR_1, SR_2, SR_3, SR_4, SR_5, SR_6, SR_7—65 ma. selenium rectifier
SR_8—300 ma. selenium bridge rectifier (Federal 1016 or equiv.)
T_1—Model airplane ignition coil ("OK Senior" by Herkimer Tool and Model Works, Inc. and available at local model shops or Thordarson 22R44)
T_2—Vib. trans. 240-0-240 @ 40 ma. (Stancor P-4060 or equiv.)
T_3—Fil. trans. 10 v. @ ¼ amp. (Stancor P-5016 can be used)
RL_1—Synchronizing relay (Jaidinger FA-103 available from Allied as #78E701)
VB_1—Four-prong non-synchronous vibrator (Mallory Type 4-4)
S_1—S.p.d.t. switch
S_2, S_3—S.p.s.t. switch
SO_1—A.c. connector
SO_2—3-wire socket
P_1—3-wire plug
B_1—Two 1½ volt flashlight cells
B_2—6-volt miniature storage battery (Willard)
Reflector—Sprague #FA-105 to match flash tube
V_1—150 watt-second flash tube (Kemlite DW-2)

Fig. 4. Schematic diagrams for (A) basic power unit, (B) flash unit, (C) booster, (D) battery unit, and (E) charging unit.

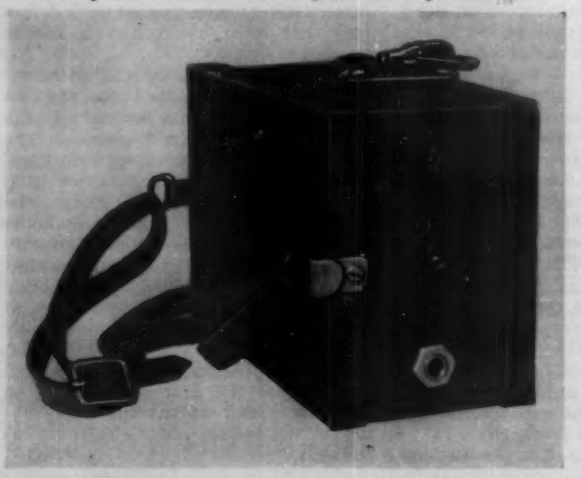
the voltage across the capacitors rises to approximately 400 volts. This indicates that the capacitors are practically up to charge and that the unit is ready to be fired. A second voltage divider consisting of resistors R_8 and R_9 together with capacitor C_4 and relay RL_1 form part of the trigger circuit, the operation of which was described previously. The potentiometer R_8, which is in series with the relay coil, is provided to give an adjustable delay for synchronizing the shutter and flash. The adjustment of this potentiometer (R_8) will be described in detail later.

Since FP-type electrolytic capacitors were used in which the can was the negative pole, it was necessary to insulate the cans from the case. This was done to avoid any danger of shock since one side of the power line is connected directly to these capacitors. A heavy kraft or fish paper wrapping provides sufficient insulation.

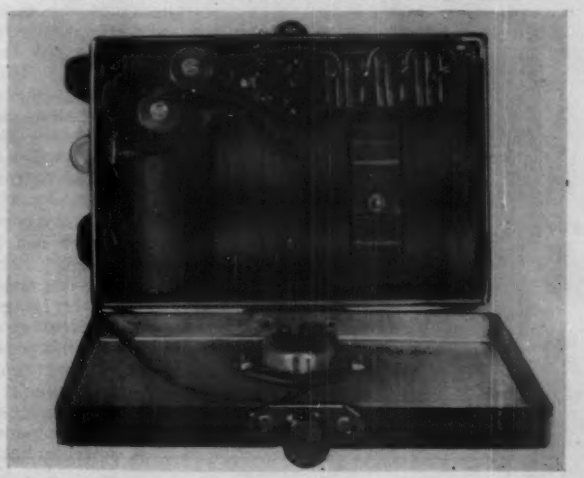
The "on-off" switch is a single-pole, double-throw switch which electrically serves a dual purpose. In the "on" position a.c. is applied to the voltage doubler input. In the "off" position a 5000-ohm bleeder resistor is automatically switched in to discharge the capacitors.

The flash unit which attaches to the

Battery unit which converts the photoflash to portable use.



Inside view of the basic power unit used for the photoflash.



camera consists of the battery case formerly used with the old type flash gun; a flash tube; a new reflector specifically designed for efficient operation with this particular flash tube; and a housing enclosing the model airplane ignition coil.

The housing was formed from a piece of aluminum bent over a short piece of pipe the same diameter as the shank of the reflector. A long bolt through the bottom edge of the U-shaped housing serves to clamp the housing to the reflector. The model airplane ignition coil is held inside the housing by means of two fuse clips over the ends of the coil. The exact arrangement for the clamp holding the housing on to the battery case is left to the ingenuity of the constructor since it will undoubtedly vary with the type of flash gun and camera that are used.

The flash tube is held in the reflector with a few drops of cement. No socket was used on the flash tube—rather the wires were soldered directly to the pins. After all, with 10,000 or more flashes between tube changes, no changes are contemplated for quite some time!

To increase the light output, a booster unit can be constructed. This increases the input from 20 watt-seconds to 60 watt-seconds by increasing the capacitance from 200 μfd. to 600 μfd. This increase in light output is particularly desirable for the slower speed films, for color work, and for working over greater distances. In the unit illustrated, four 100 μfd. capacitors are wired in parallel, insulated (for the same reason as before), and mounted in 4" x 6" x 2" box. This is the same size as the power unit. Connectors are provided on the side of each unit. The two units are then held tightly together by means of trunk fasteners of the draw type which are available in most hardware stores.

If cost is no object and the ultimate in compactness is desired, *Sprague* makes a 525 μfd., 450-volt capacitor (Type FF-1) only 2⅛ inches in diameter and 4 7/16 inches long. Each capacitor of this type is good for 53 watt-seconds. Using two of these capacitors will give over 100 watt-seconds input, which should provide adequate light for almost any situation.

Booster unit which attaches to power unit.

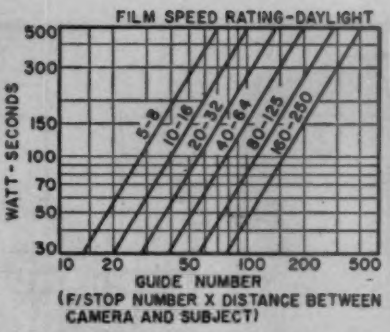


Fig. 5. Chart showing guide number vs watt-seconds (from G-E photolamp data).

Since a 117-volt a.c. source is needed to operate the power unit, it is necessary to construct the battery-vibrator unit described if any outdoor flash photography is contemplated. This unit is actually a small 6-volt d.c. to 450-volt d.c. power supply which modifies the flash outfit for portable operation —free from any and all power lines. The battery unit is constructed in a 4" x 6" x 3" aluminum box and is fastened by means of trunk fasteners as before. This allows a quick changeover from a.c. to battery operation as the demand for either arises.

The circuit is quite conventional and uses standard auto radio parts (except, of course, for the miniature 6-volt storage battery). The transformer is a small auto radio transformer used in a half-wave circuit. The centertap lead is taped up. Four selenium rectifiers are used in series to reduce the voltage per rectifier to within its ratings. The output is fed directly into the output capacitors that are found in the power unit.

When the flash outfit is battery powered, the switch on the battery unit is used to turn the equipment on and off. This switch should be left on only long enough to charge the capacitors. If any appreciable time exists between the moment the capacitors were charged and the picture taken, it would be advisable to give the capacitors an occasional "jog." This is done by turning the battery unit on for a few seconds to bring the capacitors up to full charge again. This conserves battery power and will lengthen the number of flashes per battery charge.

With reasonable care taken to conserve battery power, at least 40 flashes per charge can be obtained. This is considerably more than is ordinarily taken on one occasion. Since the storage battery is good for at least 150 charge-discharge cycles, the total number of flashes per battery is over 10,000. This assumes reasonable battery care, *i.e.*, not leaving it in an uncharged condition too long, keeping the water up to the recommended level, etc. . . .

A suitable battery charger can be constructed with a bridge-type selenium rectifier; a 10-volt filament transformer; and a 50-ohm rheostat. A suggested circuit is shown in Fig. 4E. The rheostat is adjusted to produce a maximum charging current of 250 ma. in accordance with the manufacturer's instructions. An ordinary auto battery trickle charger will also do providing some series resistance is included to limit the maximum charging current to 250 ma.

After the flash outfit has been completed, it is necessary to synchronize the flash with the shutter opening before it can be used in place of the old flash gun. This is done by adjusting the time constant of the resistance-inductance circuit formed by the relay coil and the series potentiometer R_s. As stated previously, magnesium flash bulbs have a delay of 5 to 20 milliseconds. Therefore, this approximate delay must be introduced by the relay and *R-L* circuit.

To synchronize the flash and shutter, the unit is hooked up to the camera as it would be in normal operation. The camera lens diaphragm is set to maximum opening. Now flash the unit at a blank wall and look through the back of the camera. Adjust R_s, so that the shutter blades appear completely open when the flash occurs. It would be advisable to check the synchronization occasionally, for example, between rolls of film. This is because the battery voltage also determines the delay. For this reason, it usually isn't advisable to synchronize the shutter and flash at shutter speeds greater than 1/50th of a second.

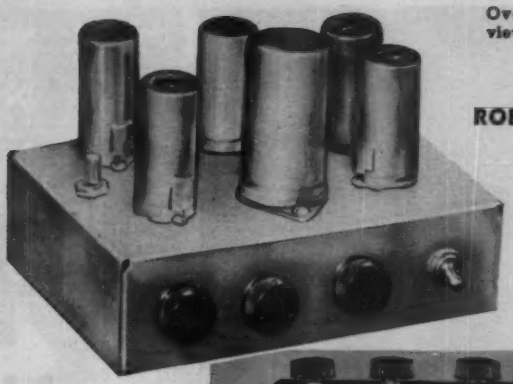
While the relay suggested in the parts list is commercially available, the constructor can experiment and reduce the cost by rewinding a small 6-volt relay. This is what was done in the unit shown. Merely remove what appears to be half the turns. It isn't too critical. Thus the ampere turns is approximately the same as before, since the resistance of the coil is halved, along with the number of turns.

An exposure chart is given in Fig. 5. However the guide numbers, as found by this chart, may vary but it serves as a good starting point. A few test shots will soon give the correction factors that must be applied to future exposures.

The completed flash outfit, all set for portable operation is shown on page 47. With all three units as shown, the total weight is only 8 pounds. The over-all dimensions are five inches high, four inches wide, and six inches long. When the flash is used on a.c., the weight is only 3¾ pounds and the height is reduced 3 inches. The construction can be simplified somewhat from the unit described by combining some or all of the units. The outfit, of course, loses some of its "universal" features.

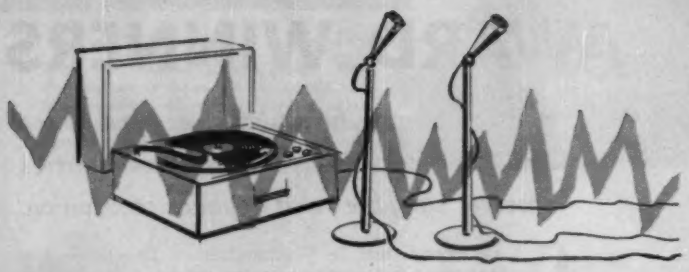
However, it is the writer's considered opinion that the unit described is an economical and worthwhile undertaking for the serious photo-electronic enthusiast. —30—

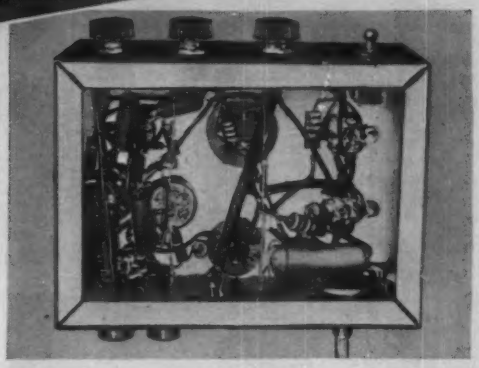
Simple 3-Channel Mixer



Over-all and bottom views of simple mixer.

By
ROBERT M. VOSS





High-fidelity mixer has provisions for two high impedance mike inputs plus a high level source.

DURING a recent recording session of a piano quintet, difficulties were encountered when it was found that the correct balance between piano and strings could not be achieved using one microphone. A hasty glance at catalogues revealed a profusion of professional mixers bristling with meters, gadgets, etc. at prices too high for the author's wallet. It was decided, therefore, to construct a mixer to meet less rigid requirements. It must be emphasized that the "less rigid requirements" do not refer to the fidelity of reproduction, but rather to the number of extra features included. The mixer had to be capable of continuously varying the relative gain of two high-impedance microphone inputs. (Later, a variable input for a high-level source was added.)

Fig. 1 shows two of the most common types of transformer-less mixing circuits. Fig. 1A is probably the more common because of its simplicity. Each input has its own gain control and the output from the tap of each control is fed, through a series resistor, to a common grid. These isolating resistors have a very important function; if they were not present, turning either control completely counterclockwise would ground the grid, cutting off the second channel as well.

It is obvious, however, that considerable signal will be lost in the series resistors—the main disadvantage of this circuit. This brings us to Fig. 1B. In this circuit, two triodes are used for two inputs, with the plates and cathodes tied together and the inputs connected directly to the grids in the normal fashion. Perhaps analysis of this circuit is simplified by drawing the equivalent circuit, shown in Fig. 1C. The schematic shows a triode, with two *parallel control grids*. Since we have effectively two triodes in parallel, the plate resistance of the combination is equivalent to one-half of that of the single section operated under the same conditions. (Each change in plate voltage will cause twice as much of a change in plate current.) Getting back to the grids, it is found that a change in grid potential will cause a certain change in the current drawn by its respective plate, with no affect on the current drawn by the other plate. Hence the transconductance remains the same. Substituting in the formula for amplification factor:

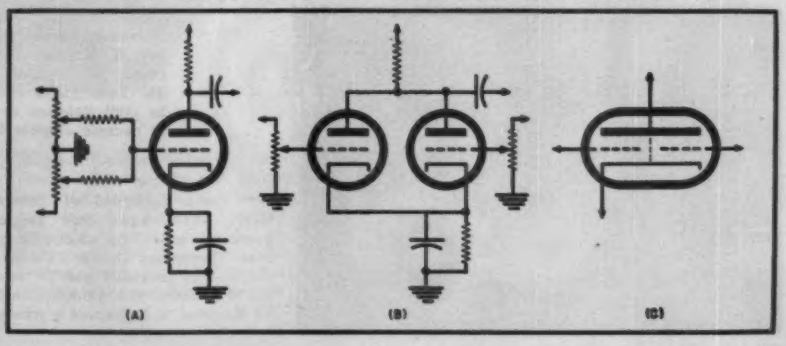
$$\mu_1 = G_m \times R_p$$
$$\mu_2 = G_m \times R_p/2$$
$$\mu_c = \mu_1/2$$

where μ_1 equals the amplification factor of the single triode and μ_2 equals that of the two sections in parallel. It is now clear that the R_p and μ of a triode operated in this manner are divided by the number of sections in parallel. For one and a half 12AU7, the arrangement used in the author's circuit, under standard conditions, typical values are: $\mu = 6$, $R_p = 2500$ ohms, and G_m (from one grid) = 2400 micromhos.

In addition to mixing facilities, the use of two high quality mikes necessitates the use of two preamplifiers, as noise considerations prevent mixing at a very low level. See Fig. 2. A 12AY7 is used as the input amplifier because of its desirable characteristics as a low-level amplifier.

(*Continued on page* 164)

Fig. 1. (A) One type of simple triode mixing circuit is shown here. (B) Another mixer circuit employing two triodes. (C) Partial equivalent circuit of part (B).



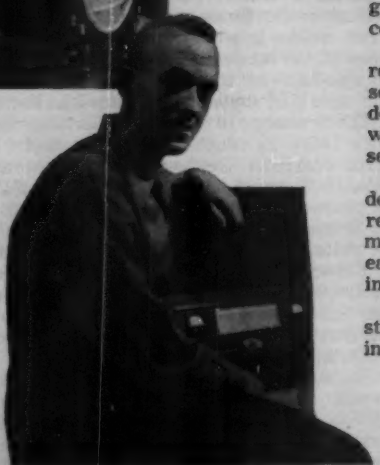
SERVICE TECHNICIANS'

ALL-AMERICAN AWARD WINNERS

General Electric honors thirteen men whose volunteer services to their communities deserve tangible and public recognition.

Richard G. Wells, Jr. of Pikeville, Ky. was one of thirteen "All-American Award" winners. He was cited for installing free TV cables in public schools, aiding in last January's flood emergencies, and for encouraging youths to study electronics.

Philip DiPace of Albany, N. Y. is active in Boy Scout work and church activities and was cited for his work toward higher business ethics and for performing free radio and TV service for older people unable to afford even nominal service fees.



Bert Rypstra of Charlotte, Mich. won his award for his outstanding service to Scouting, for rendering free radio and TV service to the needy, and for assisting in civil defense communications over his ham rig, W8NWO. →

AT A ceremony held in Washington on December 10th, thirteen service technicians were awarded trophies and checks for $500 for use in a community activity or charity of their preference. These men were selected from hundreds of nominees to receive public recognition of their extra-curricular activities which contributed to the welfare of their home towns.

General Electric established these awards for radio and TV service technicians as another step in its program of giving recognition to independent businessmen for their contributions to the welfare of their communities.

The services performed by the winners ranged from rescue operations in time of disaster to year-in, year-out service to the blind, the crippled, the orphaned, or the destitute. However, the judges readily agreed that theirs was a difficult task since all of the nominees exhibited a selflessness which would be outstanding in any community.

Ed Sullivan, Herman Hickman, Wendell Barnes, Wendell Ford, with Irvine D. Daniels, general manager of the receiving tube division as chairman, named the thirteen men pictured on these two pages. The service for which each was cited is given in the caption appended to the individual picture.

RADIO & TV NEWS joins in congratulating these outstanding technicians whose services are a credit to the industry as a whole. -30-

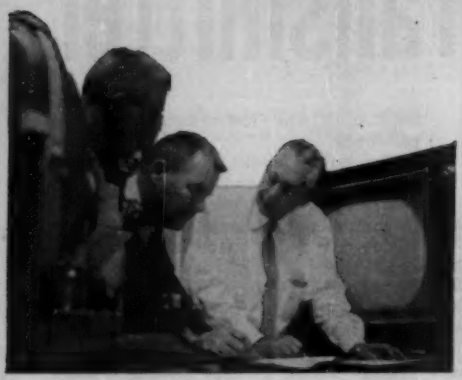
← John Stefanski of Pontiac, Mich. encouraged and helped youths to follow an electronic career, promoted better business ethics, and provided free TV service to patients at Oakland County TB Hospital, to be named a winner.

Mortimer Libowitz of Brooklyn, N. Y. assisted youths interested in electronics and used his ham radio station, K2BDQ, in civil defense communications to become eligible for an award. →

← John R. O'Brien of Evanston, Wyo. was honored for instructing first aid classes, setting up p.a. systems at community functions, and for saving several children and adults from death by drowning.

↑ Frank J. Hatler, W2EUL won recognition for his outstanding work in handling emergency communications in his home town, Roselle, N. J. His award was bestowed, in part, for his rescue work in three plane crashes.

Remo De Nicola of Quincy, Mass. → devoted many hours of his spare time to volunteer community service work with youth groups and church organizations and servicing sets for the needy without making a service charge.



← Harry E. Ward of Long Beach, Calif. has advanced the cause of electronics by assisting and encouraging education, maintaining placement files, and training groups in public safety, all without compensation.

↑ Marcus E. Denham of Pryor, Okla. was honored for his voluntary contributions to the youth training programs in his city and his wide community service through a number of organizations to which he gave his services.

Scott A. Witchner, Jr., Lampasas, Tex. used his amateur radio station, W5YIS, to save lives during the disastrous floods last May 12 and to direct ↓ local civil defense communications.

← Philip G. Rehkopf, Jr. of Louisville, Ky. was cited for installing a system of loudspeakers to enable blind children to roller skate without accidents, putting textbooks on tape for the blind, and repairing electronic equipment free for wards at Boys' Haven in Louisville, Ky.

Billy Joe Jenkins, Paducah, → Texas was honored for installing free television cable and for servicing TV sets free at Richards Memorial Hospital, assisting with Boy Scouts and Little League, and supplying p.a. systems at community functions.

Note how the tiny neon bulb is mounted so that it just touches one 25BQ6GT.

"MUSCLE MOUSE" -A Compact 50-Watt Transmitter

By JAY STANLEY

Low cost 3-band c.w. transmitter powered by the new silicon rectifiers in a safe a.c.-d.c. circuit.

HERE is a transmitter so small that with the tubes and plug-in coil removed it is very little larger than *The Radio Amateur's Handbook*. Yet it is no flea power affair: it handles a full 50 watts' input on 80 meter c.w.—and very nearly as much on 40 meters and 20 meters. It is ideal for use on either of the two most popular Novice bands and makes an excellent portable or auxiliary rig for the old timer.

The compactness of the transmitter is accounted for by the wonderful new silicon rectifiers—tiny, cool-running units which have virtually no voltage drop and handle up to 500 milliamperes of current with ease. These rectifiers and a simple a.c.-d.c. heater hookup (old stuff to the old timer—but may be very new to many of the current crop of hams) make possible a power supply which tucks neatly under a 2" x 7" x 7" chassis—along with *all* other parts.

Yes, the circuit is a.c.-d.c.—but don't go away! This particular circuit was chosen because *neither* side of the "B" voltage goes to the power line. The chassis of the transmitter can be grounded (and for that matter, should be) to an outside ground which means that this rig is just as safe as *any* standard a.c. transmitter. Actually, it is probably safer than most other 50-watt rigs, because even tangling with the high voltage (which runs about 275 volts under full load) would be a bit better than mixing it up with the 500 volts common in many 50-watt rigs. This circuit is one which depends upon fairly high current and fairly *low* voltage.

Looking at the circuit diagram, the crystal oscillator uses one 12BY7A in a Pierce circuit. This circuit was chosen because it requires no tuning—the transmitter has only one tuning coil and that is in the output stage. The latter stage uses two 25BQ6GT's in parallel. These tubes were chosen because they are low in cost (less than half as much as comparable transmitting type tubes) yet are rugged and draw plenty of plate current. On 80 and 40 meters, the tubes work "straight through" on the crystal frequency. For 20-meter operation, the transmitter "doubles" in the final output stage.

The heater voltage for the unit comes from a resistor line cord which drops the line voltage sufficiently to operate the three tube heaters—which are connected in series and "add up" to 62.6 volts. The line cord was used in preference to a resistor because it "spreads out" the heat dissipation. (The line cord normally runs somewhat warm—in case you have never seen one before). Not all jobbers stock these cords today, but the larger ones do, so there should be no difficulty in finding one.

The "B" voltage circuit uses a voltage doubling hook-up, which, thanks to the fact that 117 volts a.c. is higher than that on the peaks of the cycle, provides approximately 300 volts without load. Even heavily loaded, the power supply output is excellent, a characteristic of the low-resistance silicon rectifiers.

The parts layout is apparent from the photographs and nothing is particularly critical. It may be a good idea to mount the variable capacitor *first*, to see how much space it requires, because there is no space to spare under the chassis. If your capacitor is different in shape from the one shown, some minor layout changes may be necessary.

In wiring, note that all of the "B-minus" wiring is kept *off* the chassis. The variable capacitor mounts *on* the chassis and the rotor is connected to the "B-minus" lead by means of a fixed capacitor. This allows grounding the chassis to an outside ground, keeping the chassis "cold" and safe. Actually, as explained earlier, the "B-minus" lead also is isolated by the rectifiers from the a.c. line, which gives further protection.

Be particularly careful in hooking up the line-dropping cord to make certain that the *resistor* lead goes to the tube heaters. A mistake at this point could blow the tubes, since it could easily put full line voltage on the tube heaters. If you have an ohmmeter, identifying the resistor lead is easy. If not, you can do it by elimination: connect a flashlight battery to a flashlight bulb using the line cord to complete the circuit. Two of the leads will allow current to pass to light the bulb—but one will not, and this one, of course, is the resistor lead. The final step is to substitute a pair of headphones for the bulb to find which of the two non-resistor leads is "paired" with the resistor lead.

You will notice in wiring that plenty of ceramic bypass capacitors are used, the idea being to kill off as many sources

of TVI as possible. On 80 and 40 meters, chances are that your rig—like the one shown—will not interfere at all with a TV set in the same house—and probably won't bother TV reception even when tuned up on 20 meters. The heavy bypassing, plus the shielding provided by a bottom plate, do a surprisingly good job. Of course, in weak signal TV areas, it may be necessary to shield the tube and the coil by means of a rectangular enclosure built of *Reynolds* perforated metal.

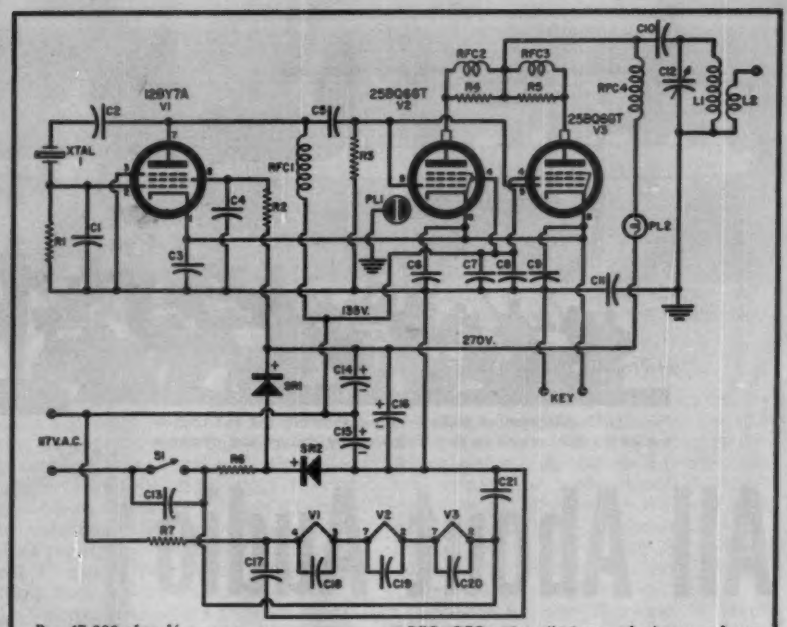
The plate circuit of the final amplifier is parallel fed, which keeps d.c. voltage off the coil, another safety precaution. The coils, plug-in for ease of changing bands, have antenna windings which are slid up and down the form to provide for proper antenna coupling and then are cemented in place.

In a low cost and simple transmitter like this one it was felt that a meter was unnecessary and, instead, two bulbs were substituted. The first is a No. 44 dial light bulb, connected in series with the "B-plus" lead. It becomes brighter, or dimmer, depending upon the current being drawn by the transmitter and is quite satisfactory as a meter for indicating resonance dip. A neon bulb, which is connected to the chassis and simply presses against the glass of one of the tubes, gives a good indication of actual r.f. output—a further aid in tune up.

The transmitter is crystal-controlled, of course. For your crystals, select the "pressure mounted" type — not the "plated" crystals, which will handle only very low crystal current. The latter are excellent for many types of circuits, but not for this one.

Wind the coils with care; current runs fairly high, and a bad solder joint might cause a lot of trouble. Be careful, too, in wiring to the plate caps,

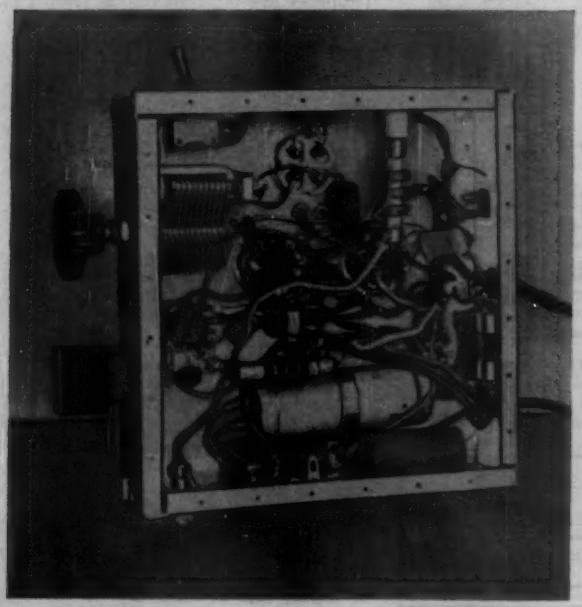
(*Continued on page* 160)



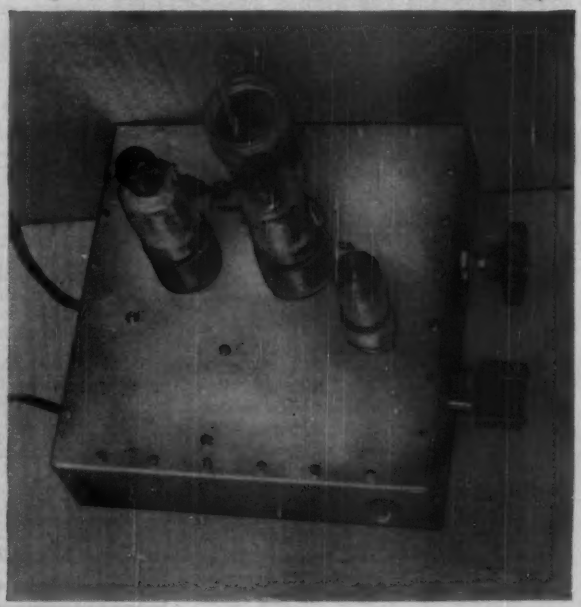
R_1—47,000 ohm, ½ w. res.
R_2—27,000 ohm, 2 w. res.
R_3—20,000 ohm, 1 w. res.
R_4, R_5—100 ohm, 1 w. res.
R_6—7.5 ohm fusible resistor
R_7—180 ohm, a.c.-d.c. resistance line cord (see text)
C_1, C_2—50 μμfd. mica capacitor
C_3, C_4, C_{13}—.005 μfd. disc ceramic capacitor
C_5—.002 μfd. disc ceramic capacitor
C_6, C_7, C_8, C_9, C_{11}, C_{12}, C_{14}, C_{15}—.001 μfd. disc ceramic capacitor
C_{16}—.003 μfd., 1000 v. mica capacitor
C_{17}—.02 μfd. disc ceramic capacitor
C_{18}—140 μμfd. (or larger) ceramic insulated midget variable capacitor
C_{19}, C_{20}—30 μfd., 150 v. capacitor
C_{21}—60 μfd., 450 v. capacitor (two 30 μfd. sections in parallel)
RFC_1, RFC_3—2½ mhy. r.f. choke
RFC_2, RFC_4—6 t. #16 enamel wire wound on R_4, R_5
SR_1, SR_2—500 ma. silicon rectifier (Sarkes Tarzian M500 or equiv.)
S_1—S.p.s.t. switch
PL_1—NE-2 neon bulb
PL_2—#44 dial light bulb
XTAL.—Crystal (see text)
V_1—12BY7A tube
V_2, V_3—25BQ6GT tube
COILS
80 m. L_1—23 t. #16 en. closewound; L_2—6 t. #18 hookup wire (adjustable, see text and photos). Wound on 1¼" polystyrene plug-in coil form
40 m. L_1—12 t. #16 en. closewound; L_2—5 t. #18 hook-up wire. Wound on 1¼" polystyrene plug-in coil form
20 m. L_1—6 t. #14 en. closewound; L_2—4 t. #18 hookup wire. Wound on 1¼" polystyrene plug-in coil form

Complete schematic diagram of the compact 50-watt rig. Two silicon rectifiers are employed in a full-wave voltage doubler circuit. Also note the use of a pilot light and a small neon lamp which serve as inexpensive tuning indicators.

Bottom view of "Muscle Mouse" shows placement of components.



Top view shows tubes and coil and the use of indicator lamps.



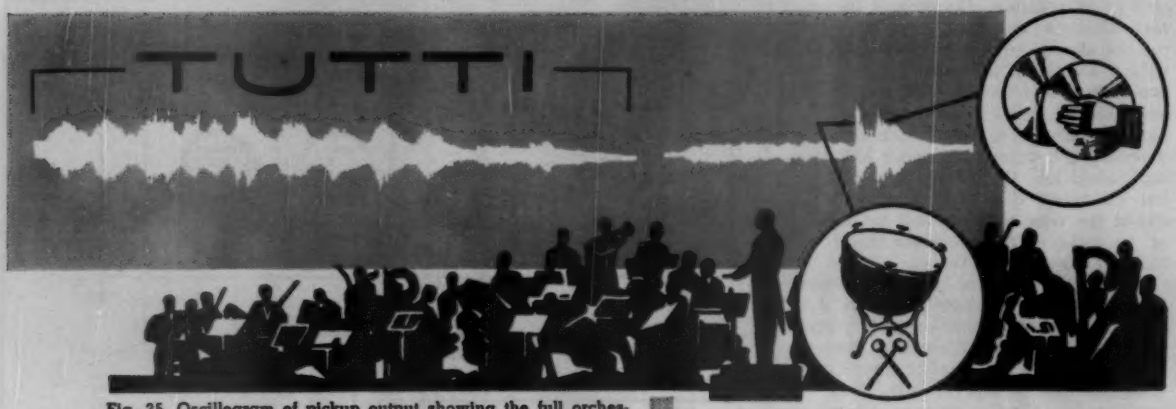


Fig. 35. Oscillogram of pickup output showing the full orchestra at the left, which is then followed by drums and cymbals.

All About Audio and Hi-Fi

SPEAKER POWER and EFFICIENCY

Part 8. Factors that determine the power handling ability and the efficiency of high-fidelity speakers.

By G. A. BRIGGS
Managing Director
Wharfedale Wireless Works Ltd.

WE HAVE seen that a diffuser can be used to subdue peaks in the upper register and reduce beaming effects. The problem can also be tackled electronically in the speaker circuit by using a filter.

A dividing network in multi-speaker systems is designed to limit the activities of each unit to its most satisfactory audio range and has become almost standard practice in wide-response installations. It is obvious that similar controls can be used on a single speaker or on two or more units working in parallel, although the full effect of a dividing network will not be obtained. There is, however, the benefit of smoothness from units working in parallel due to cancellation of resonances which rarely occur at identical frequencies in different speakers. The filter now described was made up by Mr. R. E. Cooke, and could easily be assembled at home by the average experimenter. It gives continuously variable attenuation up to 15 db centered around a choice of five frequencies, 2, 3, 4, 5, or 6 kc., selected by a switch. The "off" position of the switch enables rapid $A-B$ comparisons with unmodified response of the speaker (s) to be made without altering the resistor setting.

The filter consists of a parallel-tuned LC resonant circuit shunted by a variable resistor R. The tapped air-cored inductor L is wound by hand; the 1 μfd. capacitor C may be any good paper type obtainable from jobbers. R is a wire-wound, linear taper variable, and S is an ordinary 6-position switch. The full circuit is given in Fig. 36.

The filter is placed in series with the loudspeaker, and the switch gives maximum rejection at various frequencies as follows:—

POSITION	INDUCTANCE	CENTER OF TROUGH
1	6.2 mhy.	2 kc.
2	2.8 mhy	3 kc.
3	1.6 mhy.	4 kc.
4	1.0 mhy.	5 kc.
5	0.7 mhy.	6 kc.
6	Filter off	

With R set at its full value of 50 ohms, the maximum dip in response of about 15 db for each switch position is produced. A general picture of results is given in Figs. 39 and 40.

The air-cored inductor L consists of 303 turns of No. 18 SWG (No. 16 AWG) double cotton-covered copper wire. Tappings are brought out as shown in Fig. 36. The total resistance is only 1.2 ohms so the insertion loss is negligible outside the region of resonance.

I have been using one of these filters with an experimental speaker system which has some annoyance value in the upper middle register. It works very well, but it is difficult to decide which is the "correct" setting and I would always prefer a speaker which did not require the treatment.

The general effect is similar to the use of a so-called "presence" control on amplifiers, which I find much more baffling than simply relying on the normal bass and treble controls, which usually prove to be adequate.

But there is one possible application of the filter which can be fully recommended, and that is where a wide range speaker is being used on a commercial set not equipped with adequate tone controls and with an over-all response shaped like a salmon, with all the best cuts in the middle. A large speaker system often sounds woolly on music and resonant on speech with this type of input, and a touch of tone control

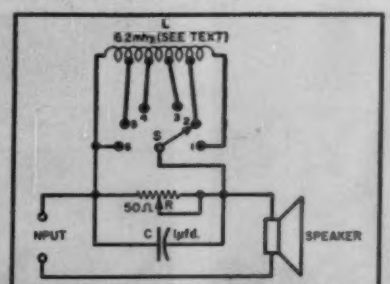
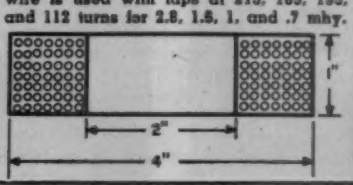


Fig. 36. Filter circuit that can be employed as tone control with speakers of 8-15 ohms impedance. (after E. M. Price)

Fig. 37. Dimensions of the 6.2 mhy. tapped coil used in the filter circuit. 303 turns of No. 18 British SWG (No. 16 AWG) d.c.c. wire is used with taps at 215, 163, 133, and 112 turns for 2.8, 1.6, 1, and .7 mhy.



in the speaker circuit often works wonders.

Power Handling and Efficiency

These qualities in a loudspeaker are so interdependent that we might as well deal with them together.

I always think that for domestic use the power handling capacity of a speaker is a very much over-rated virtue; we are concerned with how much comes out of a speaker, not with how much we can put into it.

The main difficulty is the absence of any recognized system of rating, plus the fact that the method of mounting affects results. Probably the best assessment is to listen to the speaker on full orchestra—including cymbals—and also on organ and rate it at peaks which are free from roughness, harshness, and undue boominess. Full orchestra is mentioned here deliberately because, with modern recording techniques, there is far more power in the upper register than there used to be. In fact, the hi-fi craze has often produced too much top, but there are welcome signs of a return to sanity. Distortion at high frequencies is always much more distressing to the ear than at low frequencies.

The oscillogram of Fig. 35 shows that the peak produced by cymbals is almost equal to the drums. The output from a pickup was photographed on the scope. At the left we have full orchestra for comparison with drums and cymbals that follow. It is interesting to note the steep wavefront produced by these percussion instruments; any overloading of amplifier or speaker at these peaks would obviously mar results.

Rating a loudspeaker at a single frequency is quite useless, because too much depends on the choice of frequency, and the speaker does not have to work at a single frequency—it always receives powerful harmonics. But this is not to say that *testing* a loudspeaker at a single frequency is useless. This is, of course, vital to any assessment of performance. We have already stated that method of mounting affects results. If reflex or horn loading improves the waveform at low frequencies for a given *output* of sound, then frequency doubling and trebling are reduced and so is intermodulation; but the important point is the ouput. No system can be judged merely by the amount of input it will take.

This is one reason why the open baffle is still better at the bass end than most people imagine, in spite of cut-off due to limitation of size. The cone is free to move as it likes and the sound waves from back and front enter the room without restriction. The speaker will handle fewer watts than reflex and enclosed cabinet types, but it needs fewer watts for equivalent acoustic output over most of the audio range. It is a pity that it is almost impossible to measure total speaker output, but it is very easy to measure and calculate input. (Mr. Cooke uses a sliderule, but I can still do it on my fingers.) This is why the habit of rating speakers on input and ignoring output has been so generally adopted.

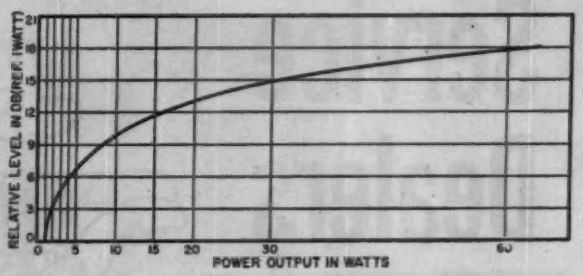


Fig. 38. Relationship between the power input to a loudspeaker and the amount of sound that it produces, taking 1 watt as reference.

It cannot be too strongly emphasized that true efficiency in a moving-coil speaker depends on flux density and this is the quality in a magnet that costs the money. And in this connection we refer to total flux, which is the product of gauss and gap dimensions (diameter, width, and depth.) It is impossible to assess the value of a magnet by a statement of gauss alone, as 13,000 lines per square centimeter with a typical 1" center pole would give 54,000 total flux, where 13,000 lines with a 1¾" center pole would produce 145,000 lines, at an extra cost of about 100%.

Magnet weight gives a rough idea of value, but as the prices of magnetic alloys vary, the weight is not a complete guide. Actually, it makes no difference to the user which type of magnet is employed; whether it is alni, alnico, alcomax, ticonal, ceramic, or hygienic does not matter. The only thing that counts in value is the total flux. All modern magnets merit the description *permanent*.

Efficiency and Watts

It is always difficult to grasp the relationship between the power we put into a speaker and the amount of sound which comes out, because a twofold increase in power produces only 3 db increase in sound pressure, which is just easily perceptible. (To the ear, the increase sounds more like 33% than 100%.) Fig. 38 shows the relationship, taking 1 watt as a reference.

Acoustically, the increase in level caused by an increase in power from 30 to 60 watts is the same as from 1 to 2 watts, but electrically it is quite a different story. As Fig. 38 shows, it pays to use a high-efficiency (*i.e.*, high flux density) loudspeaker and work on the steep portion of the curve below 15 watts, because the next 3 db are at a

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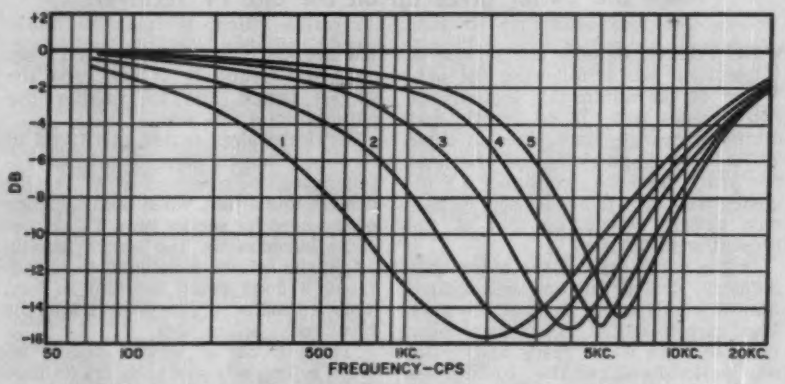
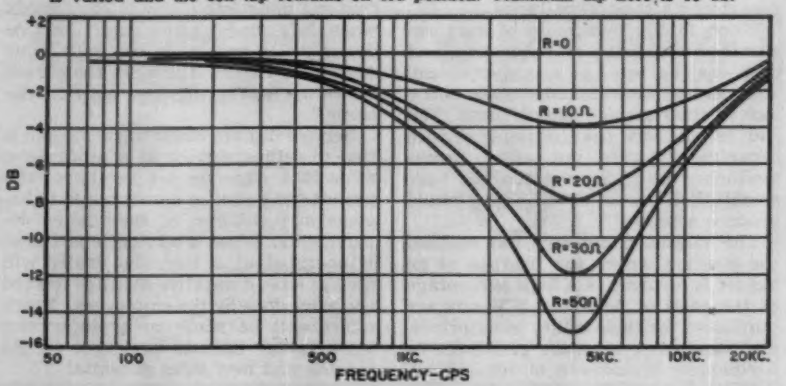
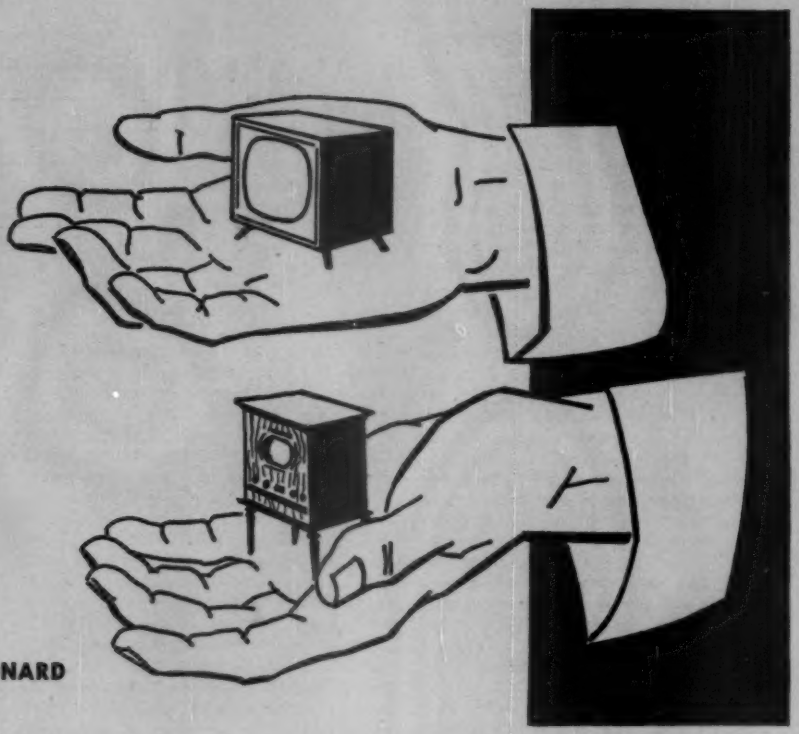


Fig. 39. Audio output response curves of the filter circuit described previously. Note that as more inductance is switched in the dip moves downward from 6 to 2 kc.

Fig. 40. These response curves show what happens to the attenuation as the resistor is varied and the coil tap remains on 3rd position. Maximum dip here is 15 db.



Service Dealers and Set Sales



By **WILLIAM LEONARD**

The service technician is the man on the scene when the owner gives up on the old TV receiver.

THE TREND in sales and service of television sets is following the pattern of the automobile industry of two decades ago. If no drastic and dramatic change takes place in color TV sets or circuitry during the next few years, the entire consumer TV industry may shift to a sales-service pattern closely resembling that of the present auto industry.

In the early days of the automobile industry, dealer thinking was geared almost wholly to the sales of new cars. Used cars presented no serious problem because there was a ready market for any second-hand car that could make a road demonstration. Minor service and adjustments could be made by the car owners. Most dealers felt that if they could break even in their service departments they were lucky.

When family ownership of cars approached the point of saturation and trade-ins became a major problem, auto dealers were forced to take a new look at their service departments. The end result was that dealers' service departments were put on a profit-producing basis. Service charges were established at a level that would produce a profit.

The television industry has reached the position where the trade-in of an old set is involved in a high percentage of the sales of new sets. TV sets are purchased for their utility in entertainment and most sales are generated by a complete breakdown of the old set. The average home owner uses a TV set until the frequency of the need for service impels him to consider the purchase of a new set.

Service dealers sensed this trend in consumer buying long before set retailers became conscious of it. Service dealers found that, when the frequency of the need for service on a TV set became burdensome, the owner usually asked the service technician to recommend a good brand for him to buy. This led many service dealers into the business of selling sets.

The attitude of service dealers toward selling sets was aptly crystallized in a statement in one of the service association house organs which said, "Strictly service shops are becoming a thing of the past. If you don't trade that customer into a new piece of goods when he's ready, some smart service dealer will—and walk off with your customer. Remember, when the old set blows up, you're the first man on the scene."

Service dealers whose basic income is tied to selling service at a profit have a decided edge on set retailers who permit their service departments to become step-children of their sales departments. When a service department is operated at a loss, the dealer will always have a negative attitude toward the work done by the employees. Every effort will be made to avoid service work rather than to exploit it for its income and new sales potential.

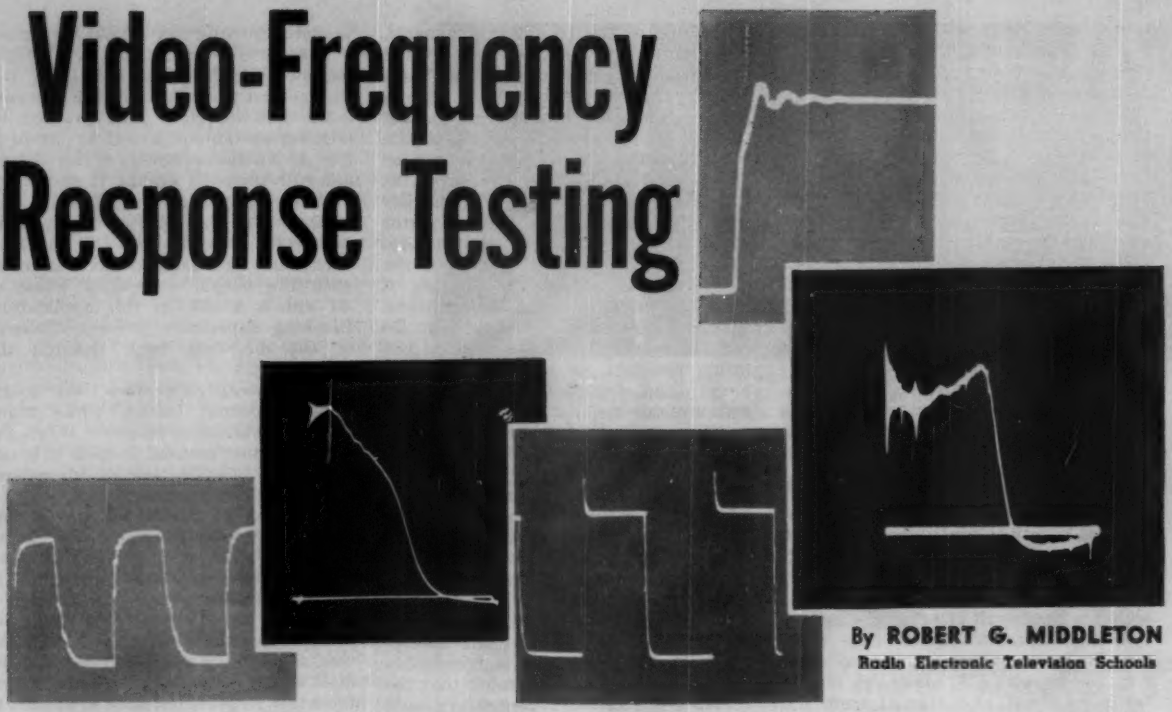
In one midwestern city, the recent action of a prominent TV-appliance retailer is typical of the "new look" TV dealers are taking toward service. In the early days of TV, this dealer was afraid of service so he farmed out his service work. This did not prove satisfactory, so he set up his own service department. Since he felt that his service should have the sole function of backing up his sales, he restricted its activities to work on products which he sold.

Operating on the assumption that low-cost service would help him make sales, this dealer held his service charges at three dollars and fifty cents for a home call when specializing service dealers found it necessary to get from five to six dollars per call to make a profit on their operations. His substandard charges failed to produce the results he thought they would. When he was faced with the loss of two of his best men who felt they were underpaid because he was using service as a sales football, he reorganized his service department to put it on a profit-producing basis.

In commenting on this change in his thinking about service, this dealer said, "The majority of independent service shops in this town charge five dollars for home service calls. Practically all of them now sell sets. While they were making money on their service work by promoting it, they also picked up lots of customers for new TV sets. Actually, they've been selling most of the better class of customers who are more interested in performance and service than they are in making a sharp trade on their old sets. We are now going to

(*Continued on page* 142)

Video-Frequency Response Testing



By ROBERT G. MIDDLETON
Radio Electronic Television Schools

Sweep and other tests, neglected but growing in importance, can be performed with basic equipment.

VIDEO-FREQUENCY sweep tests, important in monochrome work, are basic to color-TV receiver servicing. The video amplifier is located between the picture detector and the picture tube, as shown in Fig. 1. Note also that in the case of the color set, the video amplifier is called a *Y* amplifier.

The differences between video amplifiers and *Y* amplifiers are minor. We use the same methods to sweep both types of circuits. The chief difference lies in the two extra components used in a *Y* amplifier. These are a 3.58-mc. subcarrier trap and a 1-microsecond delay line.

Of course, a color-TV receiver has several more video-frequency circuits, apart from the *Y* amplifier. However, you will find that these added circuits are swept in practically the same manner as the *Y* amplifier.

We make sweep tests of video and *Y* amplifiers because good picture quality cannot be obtained unless the video-frequency circuits have sufficient bandwidth. For highest quality picture reproduction, a video amplifier should have a bandwidth of 4.2 mc.

In most black-and-white receivers, the sound signal is passed through the video amplifier, and the video amplifier therefore has appreciable gain at 4.5 mc. The sound signal is *never* passed through a *Y* amplifier—it is trapped off earlier.

A typical response curve for a video amplifier is depicted in Fig. 2. Although it looks something like an i.f. response curve, note the entirely different frequency band in the video amplifier. Note also that part of the low-frequency response between zero frequency (d.c.) and about 100 kc. is missing—this is due to test-equipment limitations, and is explained later.

The picture detector is an essential part of the video-frequency circuit. Note, from Fig. 3, that the video amplifier is driven through the internal impedance of the preceding detector. This value varies widely. It is different for a 1N60 crystal than it is for a 6AL5 vacuum tube, for example. It greatly affects the high-frequency response of the video-input circuit. Hence, an accurate sweep test of the video amplifier must take the picture detector into account: we must sweep through the picture detector. Any high-frequency loss through the detector must be compensated by adjustment of load values in the video-amplifier circuits, if the detector-amplifier combination is to do its job.

If we were simply introducing a sweep signal directly into the video amplifier, past the detector, this signal

Fig. 1. The video amplifier in (A) is located between the picture detector and the picture tube in a monochrome receiver. The Y amplifier of a color set (B) occurs in a similar location.

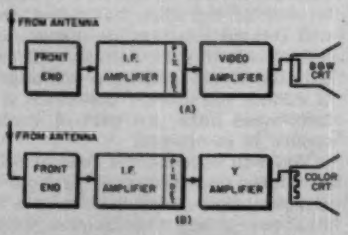


Fig. 2. Typical swept response curve of a monochrome video-amplifier stage.

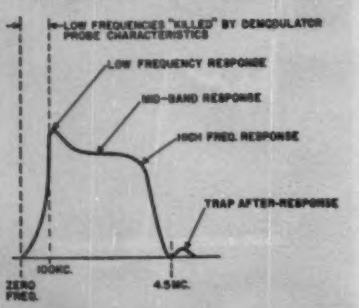
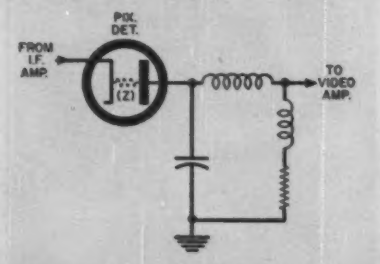


Fig. 3. The internal impedance of a video detector is shown as Z. This is an important constant in determining response of the video system.



would be in the video-frequency range; that is, it would vary roughly between zero and 4 or 5 mc. At the input of the detector, however, we introduce instead an r.f. signal. In this case, it is a swept band of frequencies in the i.f. or r.f. range, varying over a suitable bandwidth of, say, 5 mc. Also introduced at this same point (see Fig. 4) is a single-frequency signal from a conventional generator. This latter instrument is tuned to a frequency at one end of the band being swept by the FM generator. Thus, the picture detector—and, in fact, the entire video-frequency channel—is being driven by test signals in the manner that is normal for it under ordinary reception conditions. Our next concern is the nature of the signal that now appears in the video amplifier and the manner in which it can be used.

Since the detector is a nonlinear device, it is an excellent means for beating together two signals that are fed to it to produce a heterodyned output. In fact, it is in just this way that the 4.5 mc. audio i.f. is developed: this signal is the result of heterodyning the FM audio carrier against the video carrier in the detector. In the same way, the sweep (FM) generator output beats against the signal from the standard generator to produce a sweep signal that has been heterodyned down to the video-frequency range. To detect the response curve produced by this method, we will need another detector before application to the scope, just as we need another detector to recover modulation from the audio signal after it has already been heterodyned down to 4.5 mc. More will be said concerning the function of this demodulator later, just as more will be said, in detail, concerning the entire procedure outlined here in general.

Of course, we will want to mark the video-frequency response curve. This is done by applying the output from a marker generator, through an isolating resistor, to the *output* circuit of the picture detector. A marker pip or "bug" then appears on the curve, at the frequency to which the marker generator is set. An isolating resistor of 20,000 ohms is usually satisfactory. However, if the marker overloads the amplifier, use a higher value; or, if your generator has weak output, use a smaller value, such as 10,000 ohms. Do not use extremely small values of isolating resistors, or you will load the circuit and distort the shape of the response curve.

When we come down to actual practice, the general method already outlined is not quite as easy as noted, although specific difficulties are not formidable. Our first concern is to make certain that, to obtain a true picture of amplifier response, sweep input to the detector is flat. Many factors may defeat this condition.

In the first place, we must make certain that the band we are sweeping with the generator is reasonably flat. Also, we must remember that the cables from the two generators used are necessarily in parallel and that there is therefore a possibility of cable resonance or other interactions that could impair flatness of sweep. In addition, traps or other less obvious frequency sensitive components at the input of the picture detector may produce "suck-outs" in response even where the sweep signal is initially flat. Finally, harmonics of the fundamental signals we desire from the two generators could set up cross-beats to produce spurious signals that would result in distortion and consequent confusion.

There are several methods of checking sweep uniformity (flatness), but the method to be described has proven quick and effective. We proceed by hooking up the equipment as shown in Fig. 4. No disconnection of the picture detector from its circuit is necessary, in most cases. However, if a d.c. bias is present at the point of signal application (as is sometimes the case) be sure to use blocking capacitors in series with the output cables. A value of .01 μfd. is ample in this application. Blocking capacitors prevent drain-off of the d.c. bias back through the generators.

Some sweep generators have unterminated output cables, while many have a terminating resistor. When the following test method is used, it is unimportant whether the sweep-generator cable is terminated or not.

It should be understood that almost *any* pair of corresponding test frequencies may be used from the two generators. The only consideration is to use frequencies which will provide a flat sweep signal through the video amplifier. To determine suitable frequencies, observe the scope screen while the dials of the generators are being tuned from low frequencies, such as 15 mc., to high frequencies, such as 150 mc.

(EDITOR'S NOTE: While choice of frequencies is rather wide, it is not unlimited. At frequencies below the receiver i.f., the time constants in the detector circuit will tend to introduce attenuation, giving a false picture of response. Other effects are possible if the sweep generator is set to too high a frequency. In general, it is advisable to feed to the video detector a signal as near as is conveniently possible to the band of frequencies it was designed to handle—the receiver i.f. band. Going below this frequency should certainly be avoided.)

As the generators are being tuned, watch the response curve on the scope for changes in shape. Aside from nonlinearity of the sweep-generator output in some spots, you will find that generator harmonics and cross-beats may interfere with the curve shape at certain unsuitable frequencies. Fig. 5 shows a detected and displayed video-frequency response curve, obtained with the method used here. Fig. 6 shows this same curve distorted by spurious signals when a certain range of frequencies was used on the sweep generator. However, you will normally find that there is more than one frequency range over which the curve meets two tests: it will be free of interference of the kind just noted and it will remain constant in shape. Needless to say, this adjustment will be facilitated if the additional complication of adding the marker generator is not introduced until this part of the procedure is completed.

You will encounter a few situations in which uncertainty is present—the response curve may not remain constant over a very wide frequency range, so that you do not feel quite confident

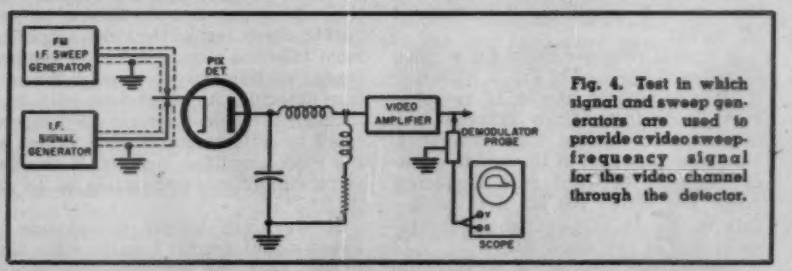


Fig. 4. Test in which signal and sweep generators are used to provide a video sweep-frequency signal for the video channel through the detector.

Fig. 5. Typical swept response curve for a video-frequency stage, such as a bandpass amplifier or video amplifier.

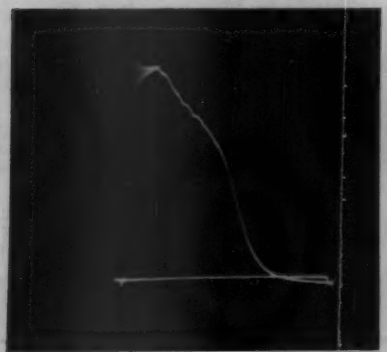
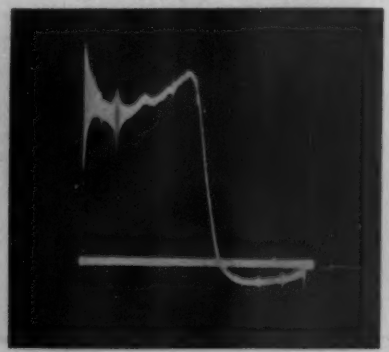


Fig. 6. This is the same curve as that in Fig. 5 but, in this case, it is distorted by spurious, interfering signals.



that the sweep signal is really flat. In such a case, it is advisable to *disconnect the picture detector input from its tuned circuit.*

It should always be possible to find suitable ranges of operation with the picture detector "open" on the input side, however, disconnection requires time and is not necessary in the great majority of cases.

The reader may ask why a demodulator probe is shown at the input to the scope. A demodulator probe is not used in i.f. alignment. However, it is used in video-frequency tests because there is no detector at the output of the video amplifier. We must supply a detector. This detector is the demodulator probe. When we sweep i.f. response only, the picture detector performs this function.

A suitable demodulator probe rectifies the video-frequency sweep signal, but passes the envelope (response curve) to the scope. A rectifier probe for a v.t.v.m. will not do, since it produces an extremely weak and distorted output. A special demodulator probe, such as the one shown in Fig. 8, must be used. It has suitable time constants for good detector action.

Since the demodulator probe has a certain amount of input capacitance it is possible, in some cases, to load the output of the video-amplifier circuit and thus attenuate the normal high-frequency response of the amplifier. Some video amplifiers are relatively load-sensitive while others are not.

In any case, it is advisable to remove the socket from the picture tube when making a video-frequency test. The input capacitance of a demodulator probe is about the same as the input capacitance to the picture tube. With the socket removed from the tube, the capacitance which the probe shunts across the output of the video amplifier will cause negligible distortion of the response curve.

It is also necessary to be aware of the possibility of overloading the video amplifier. Reduce the output from the generators, meanwhile watching the top of the response curve for any change in shape. Be sure to attenuate the generator outputs to a point below which no further change in shape of curve occurs.

You will usually find that the shape of the curve changes as the setting of the receiver's contrast control is varied. This is a normal condition and is based upon accepted ideas of picture reproduction at low-signal and high-signal levels.

Receiver manufacturers often adopt the viewpoint that reception under weak-signal conditions is improved when the high-frequency response is cut down—this characteristic does tend to minimize the visibility of snow in the picture although detail also suffers in consequence. Hence, you will often find that when the contrast control is advanced to maximum, the low-frequency end of the response curve rises faster than the high-frequency end. At a normal setting of the contrast control, the response curve should be reasonably flat.

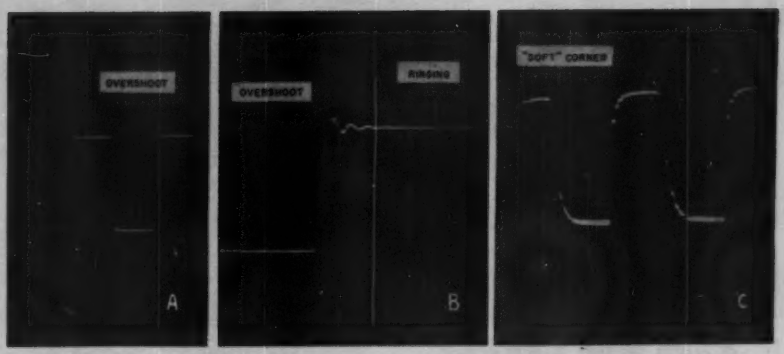


Fig. 7A. Overshoot in the square-wave output trace indicative of peaking in the high frequencies. B. This expanded trace shows overshoot with ringing, which will appear as edge distortion and circuit ghosts (or repeats) in the picture. C. Undercompensation in one amplifier followed by overcompensation in another results in reasonably square waves, but with "soft" corners.

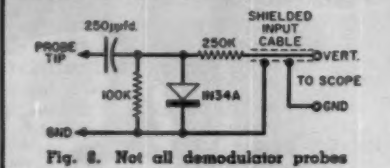


Fig. 8. Not all demodulator probes are suitable for use in video-frequency sweep tests. The one shown here has been designed for that purpose.

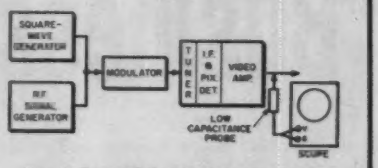


Fig. 9. By modulating a square wave on an r.f. carrier, it is possible to check through the entire video system.

Here are the circuit factors which govern the shape of the video-amplifier response curve:

1. The *low-frequency gain* is controlled by the values of the plate-load resistors—off-values will cause the low-frequency gain to be abnormal or subnormal.

2. The *mid-band gain* is controlled principally by the value of the larger peaking coils (these may be either series or shunt connected in various receivers). A shorted turn or two, *e.g.*, will produce a serious "dip" in the response.

3. The *high-frequency gain* is controlled principally by the values of the smaller peaking coils. Off-values or shorted turns cause the high-frequency response to slump off rapidly.

4. *Flatness of response* and control of "peaks" at the high-frequency end is controlled by the damping resistors across the peaking coils. Series peaking coils will often cause sharp high peaks in the response, unless suitably damped. Too low values of damping resistors cut down the high-frequency response below normal.

Some receivers have relatively narrow-band i.f. response which causes attenuation of the higher video frequencies. To compensate for this attenuation, the high-frequency response of the video amplifier may be peaked up considerably. This method provides a flat over-all frequency response, but tends to distort the *transient* response.

When one amplifier is undercompensated, and a following amplifier is overcompensated, sharp edges in the picture are "softened" and appear less distinct than is the case when both amplifiers have a flat response. On the other hand, when one amplifier is flat and the following amplifier is peaked at high frequencies, overshoot and ringing occur at sharp edges in the picture —this is a condition of "trailing reversal" accompanied by "circuit ghosts." These conditions, as they show up in square-wave tests, are pictured in Fig. 7.

To make square-wave tests of transient response of the entire video signal system, a test set-up is utilized as shown in Fig. 9. It will be observed that this is a modulated-carrier arrangement, in which square-wave modulation is impressed upon the picture carrier. Note that a low-capacitance probe is used here.

To make useful tests of transient response, it is essential to employ a square-wave generator which has fast rise time. The rise time should be about the same as the transmitted video signal or a little faster. Not all service square-wave generators meet this requirement. The generator should have a rise time not slower than .07 microsecond.

However, the generator should not have excessively fast rise time, as provided in specialized lab generators—many modulation circuits built into service generators will "ring" when impacted by excessively fast rise, and the service technician can be misled by this circumstance.

While it is obviously impossible to discuss all topics of interest under this heading, the highlights noted here serve to point out the way to serious-minded technicians who are interested in where they are going. —30—

The Two-Way Mobile Service Business

By FRANK DE BRA

A mobile unit is restored to its vehicle after bench service. Taxi companies account for a large share of the business handled by communications service shops.

Background information on a fast-growing area in electronics, which provides good income for many.

MOBILE land radio communications is two-way radiotelephone communication between vehicles, or between a vehicle or vehicles and a fixed station. The vehicle is called a mobile station and the fixed station is called the base station. Mobile marine radio communications is two-way radiotelephone communications between boats or between boats and a fixed shore station.

All mobile radio stations are licensed by the Federal Communications Commission. The FCC classifies these stations as the "Safety and Special Radio Services." These services are used by law-enforcement agencies (police and sheriffs' departments), butane and propane gas companies, construction companies, power companies, REA utilities, forestry departments—actually, the list is practically endless.

In 1953 there were nearly 400,000 of these stations licensed by the FCC. There are now in use over 500,000 units with the increase averaging about 5000 units a month. Each one of these units is a source of revenue for a technician who is capable of handling this type of service.

In addition to the mobile land stations there are numerous marine and aircraft stations which also require the services of a competent technician. No matter where you live, you are probably close enough to some phase of this business so that you can profitably get in on it.

All mobile radio stations must operate in accordance with regulations set forth by the FCC; but no communications system can be better than the maintenance it receives. No matter how good the equipment was when it was originally installed, the operating performance and conformance with FCC standards will decrease without proper maintenance.

In general radio and TV repair service, the customer normally waits until his set has broken down before he calls for service. However, mobile communications equipment often must be kept in operating condition around the clock, 365 days a year. The standards of operation are a great deal higher and the equipment may be somewhat more complicated than the general radio and television technician is accustomed to.

Mobile radio communications service must be considerably above the standards of radio and TV service. The test equipment must be more accurate and more elaborate than that used by the average radio and television technician. Because of these special requirements the financial rewards for this type of service are higher.

Most of this service is done on a contract basis. The service shop gets a set monthly fee for maintaining equipment in operation. Therefore, the income from this type of work is more regular than is that of general radio and TV service.

In addition to the steadiness of income from mobile service, the shop will find other revenue coming in automatically. Users of industrial electronic equipment will need service that the shop doing only radio and TV work is not equipped to handle. For example, hospitals have paging systems which are required to operate dependably 24 hours a day. While the equipment is not too complicated for the experienced technician to handle, the average shop has neither the test equipment nor the manpower to give the required service.

While the greatest portion of this type of service is handled on a contract basis, there is plenty of it done on a per-call, or time-plus-parts, basis. There are two ways in which contracts are made: 1. The company which sold the equipment also sells a service contract. The company then sub-contracts to a local service shop. 2. The local service shop contracts directly with the operator of the equipment. In general there are two types of contracts; labor only and labor-and-parts.

Generally speaking, the labor runs $5.00 per mobile unit and $10.00 to $15.00 per base station per month, depending on the size. And, there is other equipment, such as remote-control units, which must be maintained. The average remote-control unit runs around $2.50 per month for service. The parts are usually $2.50 extra. Thus a contract for labor alone on a ten-unit system will bring in a minimum of $55.00 each month.

A technician should be able to handle successfully and efficiently about 150 units or, say, 15 average systems each consisting of 9 mobile units and one fixed unit. Your slide rule will show you that at $55.00 per system this is a gross of $825 per month for labor.

These are just figures, of course, but they give some idea of the potential for a good technician.

In addition to the regular service, there will be installations, both mobile and fixed antenna work, and other services which do not come under the service contract. The usual charge for a mobile-unit installation is $20.00 and for the removal from one vehicle and re-installation in another is $32.50. These figures will naturally vary with location, just as other labor charges vary. However, the income from this type of service business is both regular and satisfying.

Service on a mobile transmitter can only be rendered by a qualified technician; in fact the FCC requires that he be licensed. The minimum requirement is a second-class commercial radiotelephone operator license. This restriction, in itself, greatly reduces the competition in this field. However, the license costs absolutely nothing. All that is required is to pass an FCC examination, which should not be difficult for a technician who really knows his theory. A good "Q. & A." manual can be used for study or, if you really want to better yourself, excellent correspondence courses are advertised right here in this magazine.

Once you are properly licensed you are over the biggest obstacle. In addition, though, you should study the following FCC rules:

Part 8: Rules Governing Stations on Shipboard.

Part 9: Rules Governing Aviation Services.

Part 10: Rules Governing Public Safety Radio Services.

Part 11: Rules Governing Industrial Radio Services.

Part 13: Rules Governing Commercial Radio Operators.

Part 16: Rules Governing Land Transportation Radio Services.

Part 18: Rules Governing Industrial, Scientific, and Medical Service.

Part 19: Rules Governing Citizens Radio Service.

These rules may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. They cost 10¢ each, except for Part 8, which costs 15¢. It is necessary to have this information available because, in addition to servicing the equipment, you will be called on to handle the licensing of the stations.

If you are already doing radio and TV service, you have some of the equipment you will need in mobile communications maintenance. In addition to your usual hand tools, you may need one or two additional items. If you don't already have them, for instance, a pair of good wire strippers, a good vibrator puller, and a tube puller will come in handy. The tube puller consists of a pair of metal tweezers with rubber-covered tips. Any of these extra tools can be purchased from your parts distributor. In fact, it would be a good idea to consult with him.

In addition to test equipment which is used in radio and TV repair, you will need the following equipment:

A frequency meter. The FCC requires that transmitters be maintained to within 0.01% on frequencies below 50 mc. and to within 0.005% on frequencies above 50 mc., so your meter must be accurate. The FCC requires that it meet certain specified minimum standards. In these services you may be required to measure accurately any frequency between 250 kilocycles and 460 mc. And the frequencies are constantly going higher.

An FM modulation meter. The FCC requires that stations in these services do not deviate more than 15 kc. It also requires that modulation be checked periodically, as well as frequency. The modulation meter should actually respond to voice peaks rather than to sine-wave modulation.

A dummy r.f. load. This is necessary in order to tune and adjust transmitters without causing interference to other stations.

A source of power for operating the equipment on the bench. Some of the units on which you will work will draw in excess of 50 amperes. The average battery eliminator used in automobile radio repair just can't handle this load. The best arrangement is a good storage battery with the eliminator always connected across it. Thus, the battery takes the brunt of the load, while the eliminator tends to keep the battery charged and helps on the peak loads. The power supply must be capable of handling both 6 and 12-volt units.

This equipment list is a minimum. There is other equipment that is so handy that it is almost essential, such as a good wattmeter. The equipment you get will be governed by what you need and what you can afford. Equipment for this type of service is more complicated, more accurate, more rugged, and therefore more expensive than that used in radio-TV repair.

Also manufacturers of radio communications equipment produce test equipment especially designed for servicing their own units. It is relatively inexpensive, considering what you get for your money, and also considering that service in any one shop is likely to center about one or two makes.

You will also need the technical manuals pertaining to the equipment, available from the manufacturer at nominal cost. Incidentally, in addition to the help furnished you in the technical manuals, the manufacturer will be glad to assist with any special problems you might run in to. Most companies maintain men in the field for this purpose. They will also help you

(*Continued on page* 115)

Shop in the background has realized enough income from "going mobile" to depend almost exclusively on this field.

This truck's whip antenna, sign of a mobile radio, alerts the enterprising service dealer to potential business.

Rhombic Antennas for TV

By ROBERT B. COOPER, Jr.

The photos show reception at the author's location in Fresno, California, from transmitters in Santa Barbara (175 miles away) and Los Angeles (210 miles away). Although signals traveled over mountainous terrain to a valley site, level at the receiver input ranged from 50 to 80 microvolts.

Charts for dimensions and practical construction details for a still outstanding fringe performer.

THE ANTENNA system described here is not restricted in use to any single phase of v.h.f. reception, but has found widespread acceptance in weak-signal television, FM, and amateur-band reception in the range of 50-250 megacycles. Its actual use is even then not limited to this range, but its size becomes so much out of practical proportions for the average enthusiast on the lower frequencies that we are seldom able to take advantage of its desirable characteristics below 50 mc.

For those not familiar with the general form and shape of the rhombic antenna, it is a diamond-shaped unit (Fig. 1) capable of building up large signal voltages at its terminals. The gain of the rhombic is directly proportional to the leg length of each of the four sides, with greater lengths providing greater gain. The rhombic has very sharply directive horizontal and vertical acceptance patterns, with each pattern sharpening up as the size of the antenna increases. In areas where TV and FM reception is hampered by the coincidence of two stations on the same channel, the high front-to-side and front-to-back ratios of the rhombic can often provide reception where others have failed. Several interesting variations can be found in its use. One of these is the "relay rhombic" system, which makes use of both the receiving and transmitting abilities of the antenna.

Speaking in general terms, a good example of the rhombic's pulling power is to be found in an installation built by Grant D. Ross of Marathon, Ontario, Canada. The array was approximately 6 wavelengths long per leg (at Channel 2), and mounted on poles 45 feet off the ground, on a hill 300 feet above surrounding terrain. The array was orientated for reception from WBAY, Channel 2, Green Bay, Wisconsin, some 305 miles to the south. Mr. Ross notes reception of good quality 50 per-cent of the time, fair to good 25 per-cent of the time, and fair to poor quality but 25 percent of the time. No other antenna system was able to develop a signal over this path.

Fortunately, the rhombic is not frequency sharp. Although it will provide the best reception on the channel for which it is cut, its gain will not vary greatly over a wide range. Any variation noticed will follow this pattern: less gain on frequencies lower than that for which the antenna was cut and greater gain on higher frequencies. For this reason, one need not worry about finding an area to fit the antenna but, rather, about finding the antenna size that will fit the area available.

It should be pointed out at this time that the rhombic does require a fair amount of room, ruling out such things as city lots under most circumstances. The antenna also requires a fairly clear, flat expanse, such as a cleared field.

Height above ground of the antenna may be discussed in terms of maximum and minimum. The minimum height will be dependent upon the frequency range of interest. Under no circumstances should the antenna be less than one and one-half wavelengths above ground for the lowest frequency in use. With the antenna too close to ground level, ground reflections can alter characteristics radically.

Before construction begins, care should be taken in selecting a site for the array. As the antenna system is highly directional, signal pick-up will be from one direction in a narrow lobe or beam. A clear, level field or a flat hilltop, (if one is available) are the best bets. Try to pick a location with as clear a shot in the direction of the station or stations, as possible. Keep the antenna back from busy roads, high-tension lines, and the like. Before going to the expense of erecting the antenna, make a few "dry-run" checks of the sites available.

Using a simple yagi antenna and field-strength meter, check each possible site for the amount of signal present. Once you get out of primary and secondary signal areas, the signal received may be very spotty and appear in layers. This tendency will increase as the frequency increases. It is often better to erect the antenna somewhat farther from the receiving location and to run a longer transmission line, if you can get into a better signal area.

When the work of laying the antenna out actually begins, precautions must be taken to insure that the main lobe of the antenna falls on the transmitter site of the station(s) to be received. In the case of FM and TV reception, this may not mean orientation squarely on the city from which the station transmits, as many stations have their transmitter sites in outlying

areas. A good airline map of your area will provide an excellent method of ascertaining the correct headings to be used.

If more than one station from an area is to be used for reception, orientation should be on the weakest one, for maximum pickup.

The supports needed for mounting the antenna will probably depend upon what is available in your location. In some cases, power poles or aluminum towers will be the answer. Whatever they are, the supports must be capable of withstanding fairly heavy pressures in supporting the long runs of wire. They may also require guying.

Once the support poles have been installed according to Figs. 1 and 3, the actual antenna work begins. Best results are obtained with copper-clad steel wire. The copper-clad feature will insure good electrical conductivity while the steel core will add to the over-all strength. This wire is, of course, solid, not stranded. The antenna must be mounted level. Number 12 or 14 wire is the best in this instance.

If you must solder lengths of wire together for the longer leg lengths, overlapping on the order of two feet between spliced pieces is recommended. These wires must be soldered with utmost care, as a great deal of strain will be placed on such connections during wind storms.

From Tables 1, 2, and 3, decide on the size of the rhombic you wish to use, basing measurements on the lowest channel to be received. Each chart gives measurements for three sizes of rhombics for each channel. The smallest figures are for rhombics three wavelengths per leg, the middle figures are for those six waves per leg, and the last and largest are for rhombics 12 waves per leg. Measurements are given for each TV channel up to six, the FM band, and for an average for Channels 7-13. From Table 1, select the leg length to be used. From Table 2, select the full rhombic length, which must correspond with the leg length chosen, and from Table 3, select the corresponding width. Thus, you have a choice of three sizes for each channel with both the rhombic length and width entirely dependent upon the leg length you select for your location. Line *SD* in Table 3 gives you the stacking distance for half-wave stacking, for each channel.

As can be seen in Fig. 1, two 390-ohm resistors are connected in series across the front end of the rhombic (between the two legs that join at the forward end of the antenna.) These resistors are of the ½-watt carbon variety. They must not be wire-wounds. Their purpose is to make the antenna uni-directional or terminated.

The insulators used in the construction of the rhombic are also quite important, from the aspect of mechanical stability. Heavy-duty *Johnson* 107 ceramic (hard-baked) type insulators will do the job very nicely and will stand up under strong wind and pressure loads.

For connection to the receiver, conventional 300-ohm twin-lead could be used, but the antenna-to-line mismatch will be reduced (and loss thus minimized) if a 450-ohm open-wire line is employed. For transmission-line runs of over 75 feet, open-wire line becomes even more important to avoid losses in the line itself.

EDITOR'S NOTE: *At the point where it feeds the antenna, a rhombic conventionally has an impedance of about 800 ohms. In this connection, note the author's use of 780 ohms of resistance to terminate the forward end of the antenna, which has the same impedance as the feedpoint. Even 600-ohm open-wire line would be preferred to 450-ohm line. It may well be that the author is anticipating the use of a stacked rhombic, described later. Having a lower parallel impedance, this array should match a 450-ohm line.*

Connection between the transmission line and the antenna is made by direct soldering at the points indicated in Fig. 3. Adequate support for the run of line from the antenna to the receiver should be provided to minimize wind sway. Matching the 450-ohm line to the receiver's antenna input is accomplished by the use of a tapered section of 300-ohm line, acting as a transformer. To make this up, simply split a length of flat 300-ohm twin-lead for 36 inches. The leads at the split end are connected to the corresponding leads at the end of the 450-ohm line and the unsplit remainder of the 300-ohm line feeds to the input terminals of the receiver (or booster, if used) in the normal manner.

As seen in Fig. 2, a tackle block is mounted a few inches from the supporting pole and manila rope is run through it and on down the pole to a hook for securing the rigging. The end of the rope passing through the tackle-block pulley will pass through the hole in the insulator and fold back upon itself. At this point, it is wrapped with wire and taped for ruggedness. The distance between support pole and insulator should be about 4 ft.

There are two advantages to adding a second stack to a rhombic installation. The first is the additional gain thus obtained. The second, and more obvious under normal reception con-

(*Continued on page* 109)

Length (in ft.) for Channels or Band							
	2	3	4	5	6	FM	7-13
3 λ	52	46	42	37	34	30	17
6 λ	103	92	83	74	68	60	33
12 λ	206	184	167	148	137	120	68

Table 1. Length of one leg in rhombic.

Length (in ft.) for Channels or Band							
	2	3	4	5	6	FM	7-13
3 λ	99	87	79	70	65	57	31
6 λ	196	175	158	141	130	114	63
12 λ	392	349	317	288	260	228	126

Table 2. Total length (X-Y) of rhombic.

Length (in ft.) for Channels or Band								
	2	3	4	5	6	FM	7-13
3 λ	40	35	32	28	26	23	13
6 λ	79	71	64	57	54	46	26
12 λ	158	142	128	114	108	92	53
SD	8.7	7.75	7.0	6.1	5.7	5.0	2.7

Table 3. Total width (M-N) of rhombic.

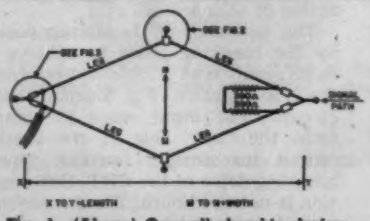
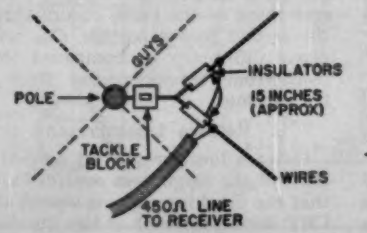


Fig. 1. (Above) Over-all rhombic design.



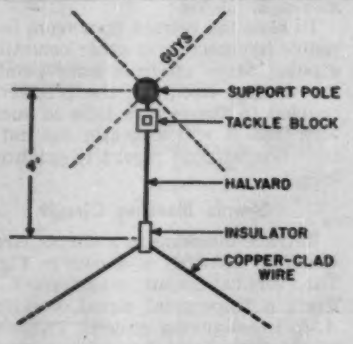


Fig. 2. Detail showing support pole and connection of the tackle blocks.

Fig. 3. Feed-line connection detail.

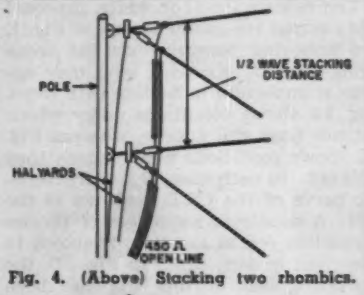


Fig. 4. (Above) Stacking two rhombics.

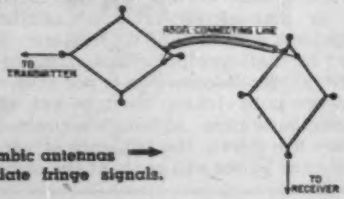


Fig. 5. Using two rhombic antennas to receive and reradiate fringe signals.

By
JAMES A. McROBERTS

Troubles in Retrace Blanking Circuits

Fig. 1. A portion of a picture-tube screen with retrace lines evident.

Although the blanking circuit is devised to remedy one problem, it can introduce others when defective.

THE SIMPLIFICATION of TV receiver design achieved by eliminating the d.c. restorer is a mixed blessing. Although viewers can see little subjective difference in the picture when the restorer is removed, the shifting d.c. level of video-signal input to the picture tube is one of the contributing factors in bringing out retrace lines. Special blanking circuits have become necessary and, as with any circuit, these are associated with troubles peculiar to their function.

The retrace lines, or white, diagonal lines across the raster shown in Fig. 1, are annoying blemishes on the scene being viewed. Knowing why they appear is important in dealing with them. Fig. 2A shows conditions under which retrace lines will appear, whereas Fig. 2B shows conditions under which they will not. In each case, the characteristic curve of the CRT is shown to the left. A couple of sequences of the information fed to the tube is shown to the right in each case. In Fig. 2B, the operating bias of the CRT has been set by manual adjustment of the brightness control (and d.c. restorer, if any) so that sync pulse tips (for simplicity, video information is not shown between pulses) keep the tube cut off during pulse time. Although horizontal pulses are shown, the sequence of vertical-sync pulses will occur at the same level.

With the picture tube biased more in the direction of white, either because manual adjustment of the brightness control has moved signal farther up on the curve or because, in the absence of a d.c. restorer, a brighter-than-average scene is being scanned, the condition of Fig. 2A prevails. The CRT is not cut off by sync pulses during the period when the electron beam retraces from the bottom of the raster back to the top, and the path of the beam on its return trip becomes visible, as shown in Fig. 1.

To keep the retrace lines from being visible irrespective of other conditions, a pulse, taken off from some point in the vertical circuit of the receiver, is coupled to the picture tube in such a way that it will maintain the cut-off condition without regard to brightness levels.

Simple Blanking Circuit

Retrace blanking in a simple circuit (*DuMont* RA-350) is shown in Fig. 3. The vertical-output transformer delivers a trapezoidal signal, waveform *A*, to the blanking circuit. The trapezoid is differentiated to produce peaked pulses by action of capacitor C_{205}, and resistor R_{206}. Waveform *B* results at the grid of the CRT.

The sharp spikes of waveform *B* must be long enough to be effective throughout the retrace time. Also, this pulse must have sufficient amplitude to drive the CRT into cut-off under all possible conditions of d.c. level normally encountered. About 60 volts peak-to-peak is satisfactory here, and for most picture tubes. The amplitude depends on operating voltages of the CRT.

Since the blanking pulse must be negative if applied to the CRT grid, the take-off for waveform *A* is at the "cold" side of the vertical-output transformer. A resistor in the "B+" feed prevents shorting of this pulse to ground by the filter (decoupling) capacitor.

In the circuit of Fig. 4, waveform *A* is developed across a capacitor, $C_{13\text{-}23}$. From it, waveform *B* is shaped by the action of $C_{13\text{-}6}$ and $R_{13\text{-}6}$.

The cathode may be driven positive by the blanking pulse to achieve the same result that is obtained by driving the grid negative. Fig. 5 depicts such a circuit. The input wave is obtained from the "hot" side of the vertical-output transformer for this type of blanking drive of the CRT. Differentiation is not used here. On the contrary, some integration is provided by capacitor C_{128} to flatten out the pulse. Further stretching of the pulse occurs through the second feed capacitor, C_{125}, with a phase difference as compared to the feed from capacitor C_{124} from the transformer.

Retrace Lines Present

Retrace lines present at normal settings of the brightness control indicate that the blanking pulse is absent at the CRT driven element or has insufficient

amplitude at that electrode. Check for a faulty blanking pulse at the CRT first.

The blanking pulse may be observed on a scope synced to half the vertical rate (30 cps). An alternative to the scope is the output function of a volt-ohm-milliammeter. The meter may be calibrated roughly against some other set known to be working. We need not be concerned as to whether we are reading r.m.s. or peak volts: since the duty ratio of all blanking pulses are nearly the same, calibration against another set will hold for field service. A headset or an earphone in series with a capacitor (about 0.01 μfd., 600 v.) may also serve as a crude indicator away from the shop.

If waveform *B* at the CRT is low in amplitude or absent, test for waveform *A* at the vertical transformer. The same indicating devices or makeshifts may be used. A peak-to-peak voltmeter can be employed, if available, as another alternative measuring instrument.

If waveform *A* is absent, the impedance across which it is developed may be shorted out. This is the resistor in the "B+" line of Fig. 3 or capacitor C_{33-10} of Fig. 4. The vertical sweep may appear quite satisfactory with these impedances shorted, although no pulse will feed the blanking network. Test the impedance by measurement or by substitution.

The series-feed capacitor may be open. After waveform *A* is known to be present, check this capacitor by shunting with another. If no improvement is noted, this capacitor may be shorted. Test by checking voltage at the CRT, or by substitution.

Partial Retrace Lines

If waveform *B* is too sharply differentiated or spiked, it will only have sufficient amplitude to blank out retrace lines at its peak, which is timed to correspond to the center of the raster. If it is not sufficiently broad in this regard, amplitude at two points along either side of the slopes, away from the peak, will not be sufficient to cut off the CRT. In this condition, retrace lines will occur at the top or bottom of the raster, or at both top and bottom, although elimination at the center is achieved.

Changes in value of the series capacitor(s) or the shunt resistor(s) make for such trouble. Leakage from the CRT electrode receiving the pulse to chassis or to adjacent base pins is another cause. Test by substitution with components of known correct value, or by checking on an ohmmeter or capacity bridge. Check for leakage with a megohmmeter, or with the high scale of a v.t.v.m. Disconnect any shunt resistance while making the leakage test. (R_{298} of Fig. 3, for example —the 39,000-ohm shunt may obscure a leakage path!)

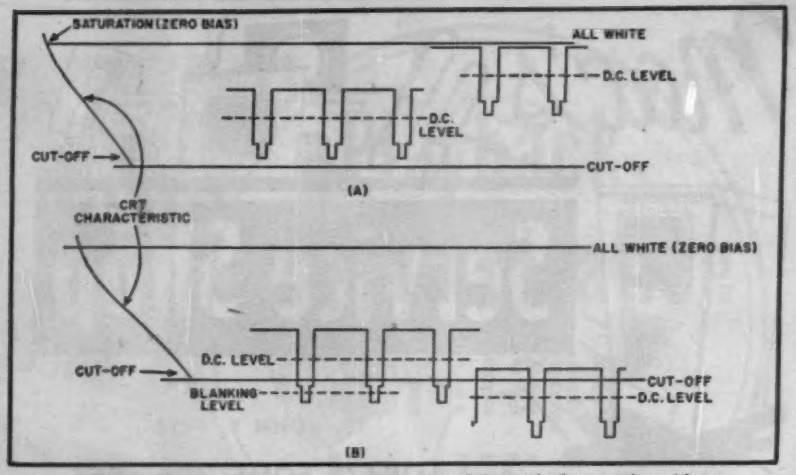


Fig. 2. The location of the operating point of the cathode-ray tube with respect to its characteristic curve determines whether the CRT will be cut off during sync-pulse time and thus during the vertical retrace interval.

Lines with Bright Pix

Although the blanking pulse may be satisfactory at the CRT for normal conditions, the CRT bias may be upset so that the beam current is excessive, causing retrace lines to appear. Voltage readings at the electrode pins will show a deviation from normal. The blanking circuit can be disconnected if it is suspected as causing this excessive brightness. The condition will persist if the retrace circuit is OK.

(*Continued on page* 135)

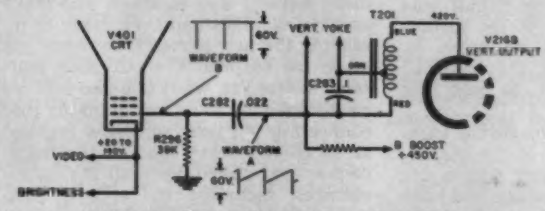


Fig. 3. The blanking pulse that cuts off the CRT is taken from the vertical-output transformer in this arrangement.

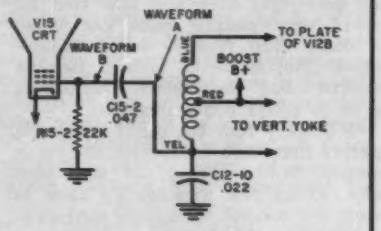


Fig. 4. The impedance across which the blanking pulse is developed in this configuration is the .022-μfd. capacitor.

Fig. 5. Here a positive pulse drives the CRT cathode.

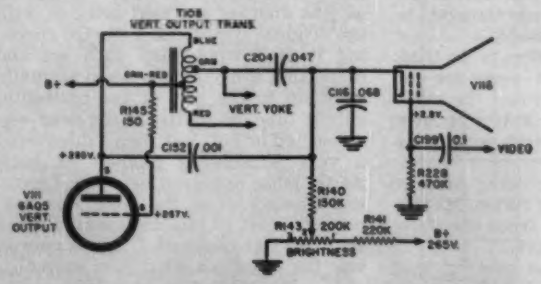
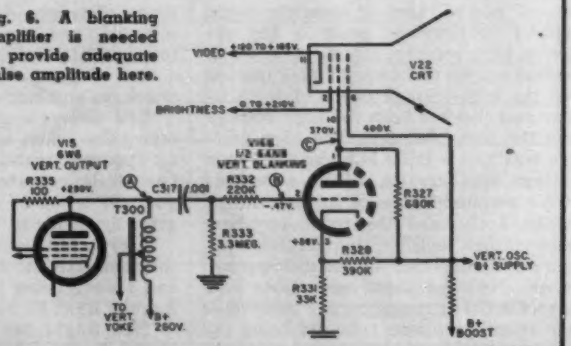


Fig. 6. A blanking amplifier is needed to provide adequate pulse amplitude here.



By **JOHN T. FRYE**

ALWAYS SOMETHING NEW

"I SAW either a dirty robin or a rusty blackbird on my way to work this morning," Barney announced to Mac, his employer, as the two of them worked side by side at the service bench.

"You're always seeing robins about a month before anyone else does," Mac scoffed. "The poet had you in mind when he wrote, 'The wish is father to the thought.' However it is hard to be sure about color at times—which reminds me that something finally happened to my color set."

"Nothing trivial, I presume."

"Nothing really serious, but it was rather interesting. All at once during a color show the picture went out of focus. As you know from working with me, one thing I can't stand is a picture out of focus. It grates on my nerves the way a crooked picture on the wall annoys a housewife or a missing motor upsets an auto mechanic. And let me tell you right here and now that an out-of-focus picture looks lots worse in color than it does in black-and-white. Not only do outlines become blurred, but the colors themselves seem to suffer contamination.

"I quickly found I could bring the picture back into focus with the focus control, but it would not stay that way. Every few minutes I'd have to reset the control to restore sharpness to the picture and the control was extremely critical in operation. The color set, of course, uses a separate focus control rectifier to produce the required high voltage, around 4000 volts, needed on the focus anode; so I trotted out the high-voltage probe of the v.t.-v.m. and checked both the high voltage and the focus voltage. The high voltage was just a trifle low and the focus voltage was erratic. With a technician's perennial hope of solving things easily, I changed the focus rectifier, high-voltage rectifier, damper, horizontal oscillator, and horizontal output tubes. None of these new tubes had any effect, but changing the high-voltage shunt regulator tube did bring up the anode voltage. However, the focus was still erratic; so I was convinced the trouble was what it looked like in the first place: a bad focus control.

"From force of habit I checked my service literature on the set to see if possibly there were any suggested changes in the focus circuit. Sure enough there were. A whole new arrangement had been worked out that was called the 'Focus Control Protection Circuit.' Obviously my set was not the only one that had lost a focus control. The replacement control was the same as the old one, but one resistor was cut out of the circuit, two new ones were added, and the high voltage for the focus rectifier was taken off a different transformer terminal. Later I had a talk with a service manager of the manufacturer and he told me that he thought the rather frequent breakdown of the focus control in the original circuit was due to momentary flashovers in the kinescope or other components, and the new circuit was designed to shunt some of the instantaneous heavy current produced by these flashovers around the control."

"I suppose you had to pull the chassis."

"Nope. The control is inside the high-voltage cage at the rear of the chassis, but when four self-tapping screws are removed and the high-voltage and yoke leads are unplugged, the whole high-voltage cage lifts right off, allowing easy access to the points you need to reach. The whole job took only a few minutes, and now the set is easily brought into focus and stays that way."

"It's a good thing you thought to check on any circuit changes."

"It's always a good idea to do that, especially when a part goes out for no apparent reason or when the same part fails repeatedly. You can save yourself a lot of callbacks and other grief by doing so."

"Hey, what were you doing here in the shop late last night? When Margie and I were going home from the show I saw a light on back here."

"You might say I was proving how stupid I was," Mac said with a sigh. "There's a guy over at the relay factory who does part-time servicing. He took on a set a couple of weeks back that had him stumped; so he wished it off on my friend, Bob Sprain, who works in the lab there. Bob quit the service game when he went into engineering a couple of years back, but he still has his equipment; and this other fellow had done Bob some favors so that he kind of had him across a barrel.

"Well, after Bob fooled around with the thing a week he decided he could use a little help, too; so last night he gave me a call and explained the deal. Bob has given me a hand time and again; so I was glad of a chance to pay him back a bit. I told him to bring the set down here and we'd see what we could find out. It was one of those situations all technicians get into now and then. You can preach 'unbusiness-like practices' and 'not helping competition' until you're black in the face; but sometimes you get into a spot where you have to be a real stinker to say, 'No.'

"In the beginning the complaint was simply no raster. The original guy soon discovered there was no high voltage. Somehow, in fooling around, he found that when the horizontal yoke was disconnected the high voltage came right up; but when the yoke was connected, the high voltage and the boost voltage both disappeared.

"Well, this fellow is apparently the sort who jumps at conclusions; so he ups and installs a new yoke. This made no difference at all. Then he concluded the horizontal output transformer must be at fault; so he put in a new one of those. That didn't help either and that is when he gave it to Bob.

"As Bob said, replacing the yoke and transformer automatically cut the ground from a lot of beautiful theories about what might be wrong. On the other hand, I had to check and make sure no mistakes had been made in installing the new parts. Experience has made me suspicious about such matters. Worse yet, what Bob had told me conditioned my mind into thinking that connecting the yoke somehow imposed an *unusually* heavy load on the transformer that pulled down all the output voltages, including the rectifier filament voltage, so that nothing was left.

"Finally, though, after I had checked and found all connections on the new transformer and yoke correct, I called a halt to my aimless fumbling around and forced myself to think of the set as just another one that came in with the original symptoms. I started checking it as I would any such set and found that everything worked normally right up to the grid of the horizontal output tube, no matter if the yoke was connected or not. But then I discovered a very substantial amount of horizontal pulse appeared between 'B-plus' and ground when the yoke was connected. Most of this disappeared when the yoke was removed. That, of course, was the tip-off on what was wrong."

(*Continued on page* 150)

Playback Standardization for Tape Amplifiers

By HERMAN BURSTEIN

Equalization standards are discussed and specific recommendations are made for shaping playback curve.

ACCURATE equalization, within 2 db or less, of phono recording characteristics has long been a requisite of high-fidelity systems. The typical proud owner of a home music system would be outraged if he found that his preamplifier departs four or five db from the RIAA playback curve when he switches to this position. Yet many an audiophile encounters errors this serious in the playback of commercially recorded tapes, which are daily increasing in quantity and quality.

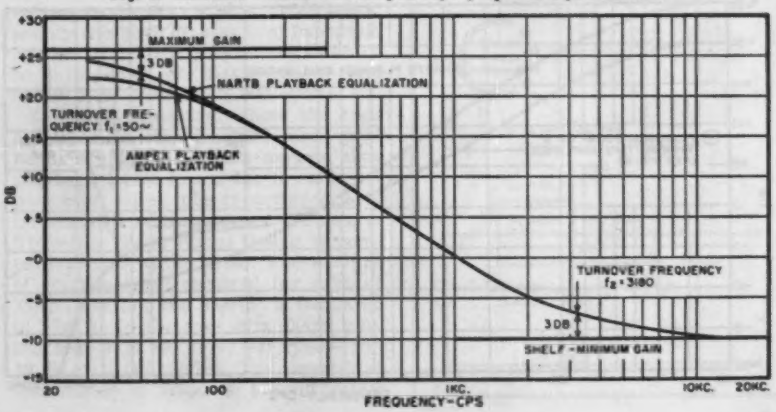
The reference here and in the rest of the discussion is to tapes operating at 7.5 ips, the speed in most common use because it is the slowest one (longest playing time) that permits a frequency response consistent with high-fidelity standards. The majority of the 7.5 ips recorded tapes call for NARTB playback equalization or *Ampex's* slightly modified curve, which differs at the very low end. *Ampex's* playback curve has about 1.5 db less bass boost at 50 cycles and about 2.0 db less boost at 30 cycles, a difference which is minor enough to be ignored here.

While most professional tape recorders of recent manufacture employ playback equalization reasonably close to the NARTB characteristic, at present the majority of moderate price ones do not. In some cases this cannot be helped because, for reasons of economy, the same equalizer network is used in both the record and playback modes, so that conformity with NARTB playback is out of the question. Other moderate price recorders, however, in keeping with the desirable practice of supplying treble boost principally in record and bass boost during playback, utilize different equalizer networks in each mode of operation. Nevertheless, although the opportunity is ready at hand, many in the latter group of recorders still fail to utilize NARTB playback equalization.

Where a tape amplifier does not employ the NARTB playback characteristic, the deviation is always in the direction of supplying less boost than called for by NARTB. The reason, in part, is that a smaller quantity of bass boost reduces the problem of hum pickup, a dominating factor in the signal-to-noise ratio of a tape recorder. Moreover, the nature of tape recorder equalization is such that the less the bass boost, the less is the required treble boost in record. Reduced amounts of equalization necessitate less gain, making for a more economical tape amplifier. The relationship between bass boost and record treble boost derives from the fact that the playback head—apart from certain high-frequency losses that will be discussed—has an output which rises 6 db per octave with increasing frequency. When a small amount of bass boost is employed, that is, when bass boost starts at a relatively low turnover frequency, then in playback the rising output of the head, in effect, supplies treble boost above this turnover frequency. Therefore less treble boost is needed during "record."

The following discussion will first describe NARTB playback equalization. It will then examine a typical case where a tape amplifier of good quality, using a separate equalizer for playback, departs from the NARTB curve, so that it may be seen how serious are the resulting errors when a commercially recorded tape is played. The third part will discuss a popular bass boost circuit which lends itself to exact shaping of the playback characteristic. Lastly, means of compensating playback head losses will be

Fig. 1. Standard NARTB and Ampex tape playback equalizations.



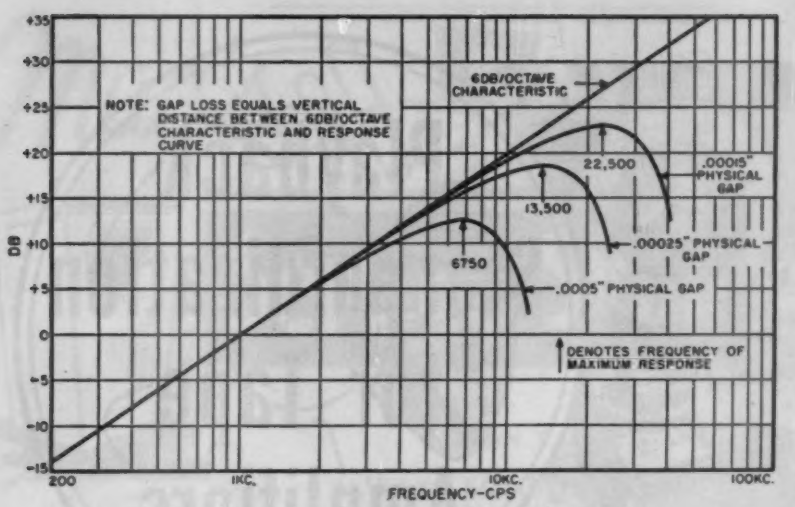


Fig. 2. Response of playback head at 7.5 ips to flat signals.

described inasmuch as these losses are a part of the total playback characteristic.

Promulgated in 1953 as the official standard for 15 ips tape recording, the NARTB playback curve has become an unofficial standard for 7.5 ips as well. This development may be ascribed to *Ampex's* adoption of the NARTB curve (in essence) for 7.5 ips and to the widespread use of *Ampex* equipment in the tape recording industry.

Fig. 1 shows the NARTB playback characteristic as well as *Ampex's* slightly modified version of it. Record equalization must be such as to result in more or less flat response, with one important exception: To the extent that there are playback treble losses serious enough to require compensation, these losses must be equalized *in playback*. Fig. 1 does not include treble boost for compensating playback losses inasmuch as these vary from recorder to recorder. Playback treble losses are chiefly due to gap width of the playback head. The wider the gap, the greater the losses.

Losses at 7.5 ips due to gap width are indicated in Fig. 2 for three commercially available heads. Inasmuch as tape heads have a 6 db per octave rising characteristic with frequency, gap loss equals the vertical distance between the 6 db per octave line and the head response to a flat recorded signal, as represented in Fig. 2. In the case of a very narrow gap, the loss may be small enough within the audio range so that no treble boost is considered necessary.

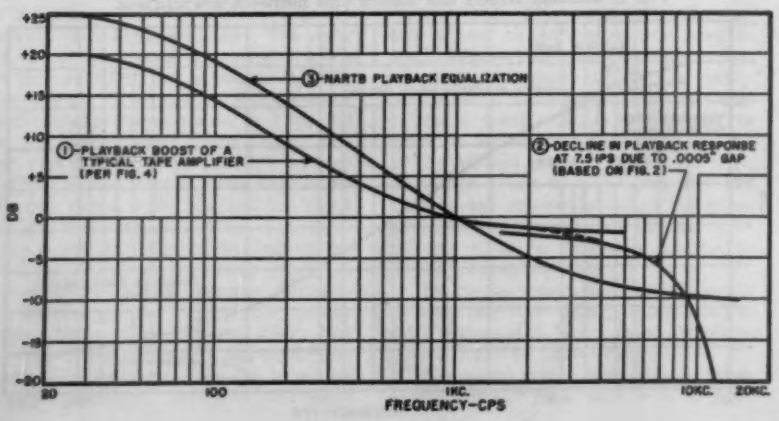
Returning to Fig. 1, it can be seen that the NARTB curve entails a relatively tremendous amount of bass boost, 36 db all told. There are two turnover frequencies. The principal one occurs at 3180 cycles, where gain is 3 db below minimum. The lower turnover frequency is at 50 cycles, where response is 3 db below maximum.

Non-NARTB Characteristic

Curve 1 in Fig. 3 shows the playback curve of a high-quality tape amplifier, one that was described in the December, 1956 issue of this magazine.[1] The curve is based on the values given in the schematic of the article, and has a lower turnover frequency of about 50 cycles and an upper one of about 700 cycles. As described in the article, the amplifier is used with a .0005" head, resulting in a fall-off in playback response approximately as shown by Curve 2. Total playback response is therefore the sum of Curves 1 and 2. Comparing total response with the NARTB characteristic, it may readily be seen that equalization is deficient in bass and excessive in treble by 4 db or more over substantial portions of the audio spectrum.

Fig. 1 is not intended to be critical of a particular amplifier. Rather, it shows a typical situation. To remedy this situation, it is necessary to alter the values employed in the bass boost circuit and to provide for treble boost that will compensate the treble losses due to the head.

Fig. 3. NARTB curve and curve used in high quality amplifier.



Shaping the Bass Boost

Fig. 4 shows, with a slight modification introduced for the sake of simplicity,[2] the playback boost circuit employed in the amplifier previously referred to. It is one of several variations of a popular and relatively simple circuit, which permits bass boost to be easily shaped with the desired degree of precision.

To understand how the circuit of Fig. 4 achieves bass boost and how this boost may be shaped, it is first necessary to reduce it to an equivalent circuit, as shown in Fig. 5. Fig. 5A shows that the input tube's plate resistance (r_p), load resistor (R_L), and following grid resistor (R_g) are effectively in parallel with each other and in series with equalization capacitor C and equalization resistor R to ground. C_1 of Fig. 4 has small enough reactance to be ignored. Fig. 5B simplifies the equivalent circuit, with R_1 being equal to r_p, R_L, and R_g in parallel.

At very high frequencies, where C has relatively little reactance, R_1 and R form a voltage divider. The gain remaining after voltage division constitutes what may be referred to as a shelf (see Fig. 1). As frequency declines, the reactance of C increases and the output leg of the voltage divider increases in relation to R_1, so that output increases. At the frequency where the reactance of C equals R, response is 3 db above the shelf. This is the upper turnover frequency, f_2. In the case of the NARTB curve, f_2 occurs at 3180 cycles (see Fig. 1). With further decline in frequency, the reactance of C and output continue to grow. However, when the reactance of C approaches R_1 in magnitude, the increase in output nears an end. At that frequency, f_1, where the reactances of R_1 and C are equal, output is 3 db below maximum. For the NARTB curve, f_1 is 50 cycles.

Given the input tube's plate resistance, load resistor, and following grid

1. Johnson, Maurice: "A Professional Tape Recording Amplifier for Home Hi-Fi Systems."
2. In the original circuit, capacitor C was connected after coupling capacitor C_1 rather than directly to the plate of the input tube. Inasmuch as the two capacitors were in series as far as equalizer action was concerned, the value of C_1 had to be taken into account in calculating the appropriate value for C. With C connected directly to the plate, the value of C_1 may be ignored, simplifying matters.

resistor, the value of R_1 can easily be calculated, being the parallel value of these quantities. For the circuit of Fig. 4, R_1 is about 150,000 ohms. C is approximately determined by formula $C = 1/2\pi f_1 R_1$. If f_1 is to be 50 cycles according to the NARTB standard, then C is approximately .02 μfd. R is determined by the formula $R = 1/2\pi f_2 C$. If f_2 is to be 3180 cycles per NARTB, R is about 2500 ohms. A variable resistor is often used for R so that the upper turnover frequency, which is of principal importance, may be obtained with the desired precision.

In some instances a triode input tube is used in place of a pentode. Triodes have much smaller plate resistance than pentodes, so that the resulting value of R_1 per the equivalent circuit of Fig. 5B is a good deal less. This will result in a larger value for C and a smaller one for R.

As previously stated, Fig. 4 is but one of several variations of a basic circuit. It has been shown that the plate resistance of the input tube plays a part in determining the lower turnover frequency. But plate resistance may vary from tube to tube of the same type, or it may change as the tube ages, thus altering the lower turnover frequency. This problem is more severe with a triode than a pentode because the triode, having a low value of plate resistance, is the principal factor in determining R_1. To minimize the effect of the triode's plate resistance upon R_1, the circuit of Fig. 6 is sometimes used, R_a (typically 100,000 ohms) being added. As shown in the equivalent circuit, R_a is effectively in series with the parallel combination of r_p and R_L; R_g is in parallel with all the rest. Thus changes in r_p have relatively little effect.

The circuit of Fig. 6 has both a corollary advantage and disadvantage. The advantage is that playback treble boost may be obtained easily by bypassing R_a with a suitable capacitor, thus helping to compensate for head and other playback treble losses. The disadvantage is that the addition of R_a may result in high-frequency losses. One of the difficulties in using triodes for high-fidelity purposes is their relatively high input capacitance due to Miller effect. Input capacitance is a function of tube gain. In the circuit of Fig. 4, there is very little gain at high frequencies because of the loading effect of R and C; that is, C is a virtual short circuit and R is only a few thousand ohms. In the circuit of Fig. 6, however, interposition of resistor R_a prevents the equalizer components from loading down the tube at high frequencies. Therefore gain remain high and so does input capacitance.

Also frequently used for bass boost is the feedback network shown in Fig. 7. This has the virtue of minimizing distortion at frequencies where feedback is appreciable (treble range). On the other hand, it is more difficult to obtain precise equalization with a feedback circuit because gain does not vary inversely with feedback but varies inversely with the quantity $1 + AB$, where A is gain without feedback and B is percentage of output voltage fed back. To have a linear relationship between gain and feedback, it is necessary to start with a great deal of gain so that the factor AB is considerably greater (at least four times) than 1 throughout the range where equalization takes place. On the other hand, if there is too much feedback (too high a value of B) in order that AB should be at least 4, there is danger of overloading the output tube, with consequent distortion.

The circuit of Fig. 7 operates as follows: At very low frequencies (below 50 cycles), the shunt reactance of C is so great that feedback is limited to a very small value by R_1, which is 620,000 ohms. As frequency increases, the reactance of C decreases, bypassing R_1, increasing feedback, and decreasing gain. At 50 cycles, C's reactance equals R_1; at this point feedback has increased 3 db and gain has dropped 3 db. With further increase in frequency, the reactance of C continues to drop, so that feedback rises and gain declines. When the reactance of C starts to become as small as R_2 plus R_3, then feedback is essentially limited by these resistors; hence feedback approaches a halt and gain no longer drops as fast. C's reactance equals R_2 plus R_3 at 3180 cycles, where gain is 3 db above minimum. In order to precisely control the upper turnover frequency, R_2 should be variable.

Compensating Treble Losses

While gap width is the principal reason for playback head losses, hysteresis and eddy current losses in the head also produce a drop in treble response, although in a well-designed head the latter losses are minor, perhaps only one or two db at 15,000 cycles. Furthermore, there may be some treble losses due to capacitance of the cable between the playback head and the input tube and due to input capacitance of this tube. All these losses, to the extent that they exist, should be compensated in the playback amplifier so that response is reasonably flat to at least 10,000 cycles and possibly to 15,000 cycles. On the other hand, it is not necessary to maintain flat response to 15,000 cycles to completely satisfy the NARTB standard inasmuch as this standard permits response to be 4 db down at 15,000 cycles (and about 2 db down at 10,000 cycles).

Generally speaking, where the tape amplifier is well-designed and good heads are used, one can assume that playback treble losses due to cable capacitance, input tube capacitance, hysteresis, and eddy currents are minor. Therefore the principal task is to compensate gap width losses. The amount of compensation required for gaps of .0005", .00025", and .00015" is indicated in Fig. 2. In the case of a .0005" gap, the loss is 11 db at 10,000 cycles and 19 db at 12,000 cycles. The severity of the decline in response beyond 10,000 cycles makes it impractical to strive for flat playback response beyond this frequency when using a .005" gap. It must be recognized that to the extent treble boost is used to elevate the audio signal, various forms of high-frequency noise are also accentuated.

Playback response flat or nearly flat to 15,000 cycles is quite feasible with a .00025" gap. At 15,000 cycles, response is down only 5 db, easy enough to compensate. In fact, *Ampex* recorders, which use heads with a .00025"

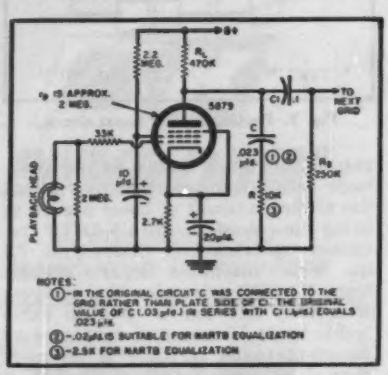


Fig. 4. Playback equalizer of amplifier.

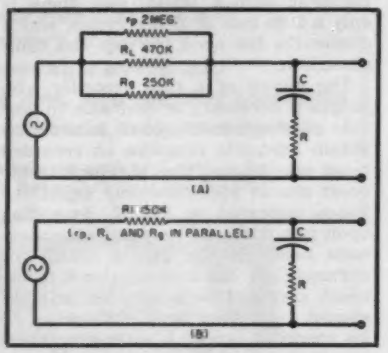
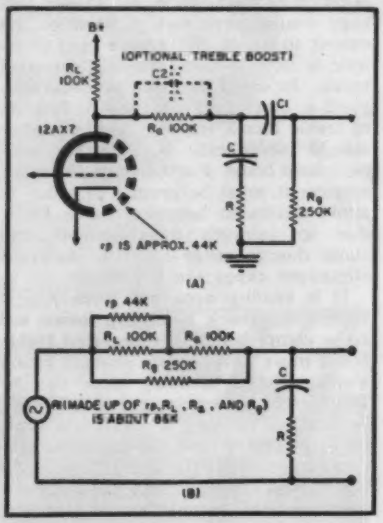


Fig. 5. Configurations for the equivalent circuits to that shown above in Fig. 4.

Fig. 6. Modified bass boost circuit to minimize effects of plate resistance change.



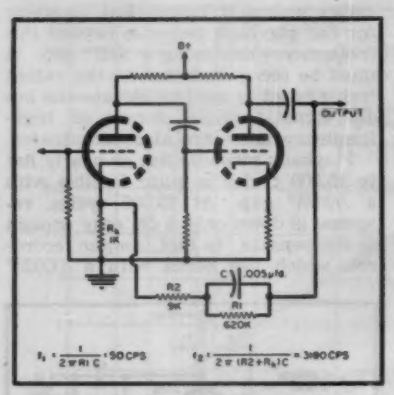


Fig. 7. Feedback bass boost circuit.

gap, do not even bother to use playback treble compensation in view of the trifling amount of boost needed to bring the recorders up to NARTB frequency specification. Instead, at 7.5 ips these machines depart slightly from NARTB principles by supplying something like one or two db extra treble boost *in record* so that over-all record-playback response is no more than 4 db down at 15,000 cycles, as stipulated by NARTB. In the case of the head with a .00015" gap, there is only a 2 db loss at 15,000 cycles, which eliminates the need for gap loss compensation.

The owner of a tape recorder who judges it necessary or desirable to provide playback treble boost in order to obtain adequate response on recorded tapes may assume that playback treble boost should approximately equal the losses indicated in Fig. 2, depending upon gap width of his particular playback head. If the gap is .00025" or narrower, he can omit playback treble boost, provided he is satisfied with response 4 db down at 15,000 cycles on his recorded tapes. A safer procedure, one that would show up not only gap losses but all other forms of playback treble loss, would be to check response when playing back a frequency tape recorded essentially according to the NARTB characteristic. An *Ampex* test tape would serve well in view of the extent to which the *Ampex* characteristic is used in commercially recorded tapes. In order for this procedure to yield a clear and accurate indication of treble losses, the playback amplifier should incorporate NARTB (or *Ampex*) bass boost. Furthermore, azimuth alignment must be precise in order to avoid confusion between treble losses due to azimuth misalignment and those due to other sources. Azimuth alignment tapes are available.

It is readily apparent from Fig. 2 that, if playback head gap losses are to be compensated, the required treble boost must have a very sharply rising characteristic. A steep slope can be obtained by several stages of *RC* boost, each stage yielding a maximum slope of 6 db per octave. A common procedure is to omit the usual large cathode bypass capacitor and use instead a suitable small value. Thus at low- and mid-range frequencies there is current feedback and reduction in gain due to an essentially unbypassed cathode resistor, while at high frequencies the capacitor reactance becomes small enough to bypass the resistor, decreasing feedback and increasing gain. By repeating this procedure in two or more amplifier stages, a fairly sharp treble boost may be obtained. Of course, this procedure involves a loss of gain at low- and mid-frequencies, so that the playback amplifier must have sufficient reserve gain to permit this modification.

As previously discussed in connection with Fig. 6, treble boost can be obtained without any additional sacrifice in gain by placing a capacitor of suitable value across R_a. Value of the capacitor is determined by the formula $C_s = 1/2\pi f R_a$, where f is the frequency at which it is desired that treble boost shall be 3 db up. Additional stages of treble boost are still needed to produce the required slope.

A sharply rising treble boost characteristic can be obtained in one stage by using *LC* components. An example is Fig. 8. The large cathode resistor R_f produces substantial current feedback and reduces gain. This resistor is paralleled by *LC* in series. As *LC* approaches resonance, its impedance decreases rapidly in the manner of a tuned circuit, so that R_f is bypassed. As a result, gain rises sharply. The values shown in Fig. 8 produce a peak in response at 16,000 cycles, although a lower resonant frequency would be suitable for a .0005" head inasmuch as response much beyond 10,000 cycles is impractical for so wide a gap. Given the desired resonant frequency and given the value of L, the value of C is obtained by the formula $C = 1/(2\pi f)^2 L$. A TV width coil in the range of 20 to 50 mhy. is suitable for L. The amount of boost produced by the circuit of Fig. 8 depends upon the value of R_f. The larger its value, the greater the boost. The size of R_f should be experimentally determined and will ordinarily range between 5000 and 50,000 ohms.

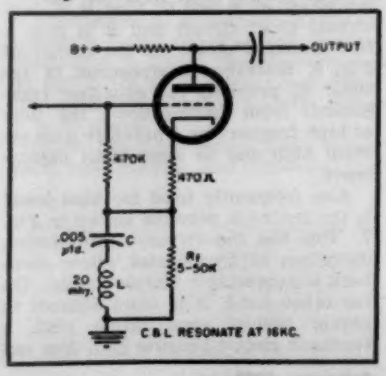
Another basic method of producing a sharply rising characteristic is to resonate the playback head with a capacitor. The value of the capacitor will probably lie between .0001 and .001 μfd., depending upon head inductance and the desired resonant frequency. Playback heads generally have an inductance ranging between .25 and 1 henry. Assume, for example, that the head has an inductance of .5 henry and it is desired to resonate the head at 15,000 cycles. Then a capacitor of .00022 μfd. is indicated by the formula $C = 1/(2\pi f)^2 L$. Of course there is no guarantee that the rise in response due to resonating the head will exactly match the gap loss. Often, however, there is enough of a correspondence to make this a worthwhile procedure, especially since it is a simple and inexpensive method and costs nothing in terms of gain. The resonating capacitor can be switched in during playback only, or it can be left in permanently, so that it also produces treble boost in the record mode. Correspondingly, the record treble boost circuit would have to supply that much less pre-emphasis.

Given a tape amplifier that meets NARTB qualifications for playback—NARTB (or *Ampex*) bass boost as shown in Fig. 1 and compensation, if needed, for gap and other treble losses—it remains for the amplifier to supply record equalization that produces over-all flat response. It is not the purpose of this article to discuss the modifications required to produce such response. It may be said here, however, that treble boost circuits along the lines of those indicated in Figs. 6 and 8 are commonly employed; also, the use of small cathode bypass capacitors is frequent. The behavior of these circuits has been explained, and the reader wishing to do so can experiment with various component values to achieve the desired record equalization.

It should be pointed out that use of the NARTB characteristic in playback involves putting a relatively large amount of signal on the tape at high frequencies in record. This necessitates substantial amounts of treble boost if bias current is to be great enough to hold distortion to an acceptably low value; the more bias, the larger are the treble losses in record. A considerable amount of record treble boost, in turn, requires that the tape amplifier have sufficient reserve gain from which this boost can be drawn. If the amplifier is quite marginal in the sense that it has very little record gain to spare, it is fruitless to attempt to modify the amplifier so that it conforms to NARTB requirements. Most tape amplifiers, however, have an appreciable amount of reserve gain, so that it is practical to modify them in accordance with NARTB principles.

If the owner does not wish to tamper with the record equalization of his machine, yet desires accurate playback of commercially recorded tapes, another course is open to him. By means of a switch, the proper capacitor and resistor values for NARTB playback equalization can be inserted into the playback equalizer whenever desired. —30—

Fig. 8. RLC treble boost circuit.



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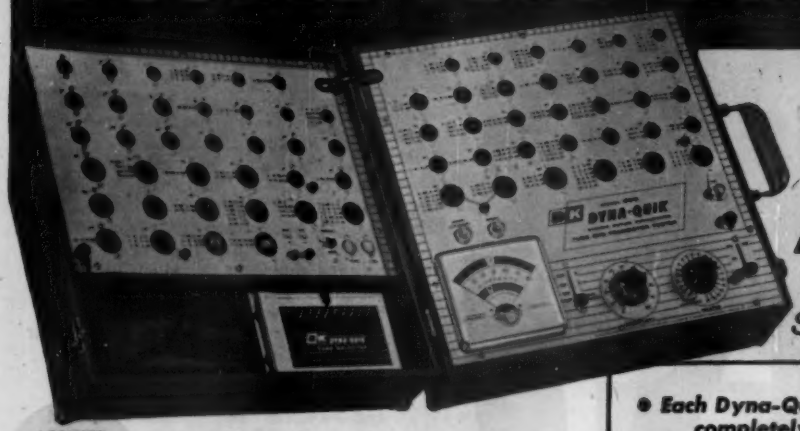

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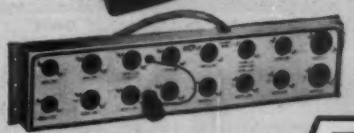

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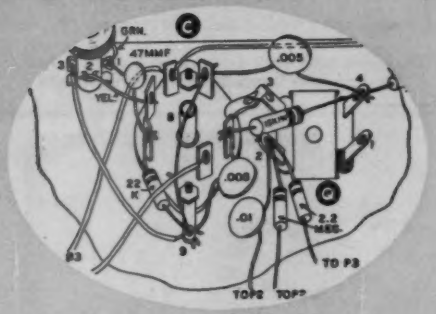

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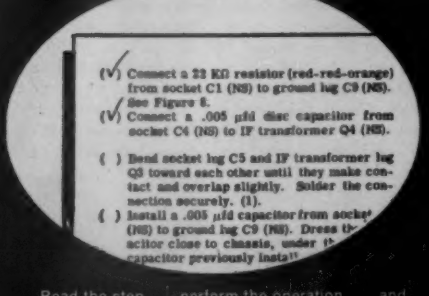
(✓) Connect a 22 KΩ resistor (red-red-orange) from socket C1 (NS) to ground lug C9 (NS). See Figure 8.
(✓) Connect a .005 μfd disc capacitor from socket C4 (NS) to IF transformer Q4 (NS).
( ) Bend socket lug C5 and IF transformer lug Q3 toward each other until they make contact and overlap slightly. Solder the connection securely. (1).
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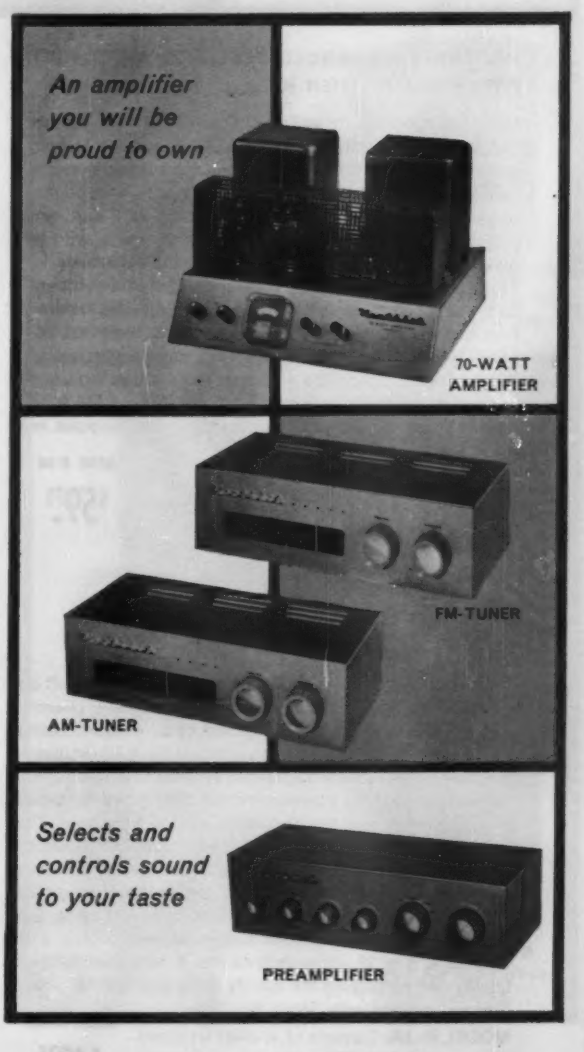

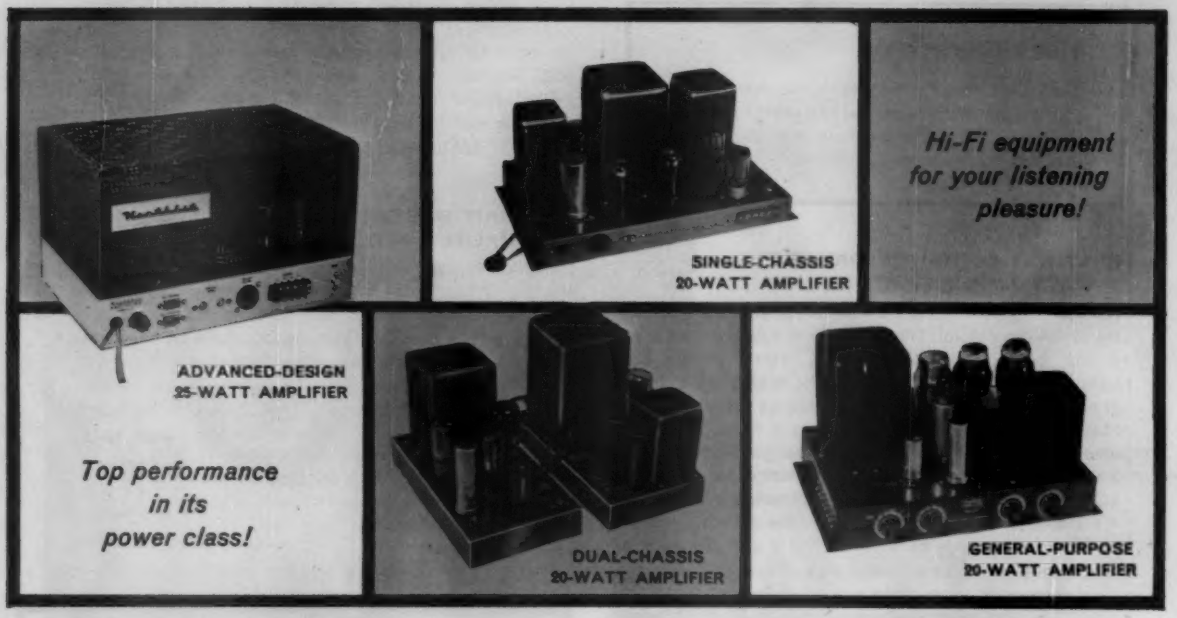

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$59.75

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3AM

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

$49.75

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ±1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

MODEL W4-AM

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50.

$39.75

Heathkits...

By DAYSTROM

bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ±1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C

$35.50

HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ±5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11½" H x 23" W x 11¾" D. Constructed of veneer-surfaced plywood, ½" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

MODEL SS-1
$39.95

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Extends the range of the SS-1 to ±5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17½" D. Constructed of veneer-surfaced plywood ¾" thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B
$99.95

Heathkits...

By DAYSTROM

let you save up to ½ or more on all types of electronic equipment.

HEATHKIT SINE-SQUARE GENERATOR

The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are; radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ±1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

MODEL AG-10
$49.95

HEATHKIT AUDIO ANALYZER KIT

The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

MODEL AA-1
$49.95

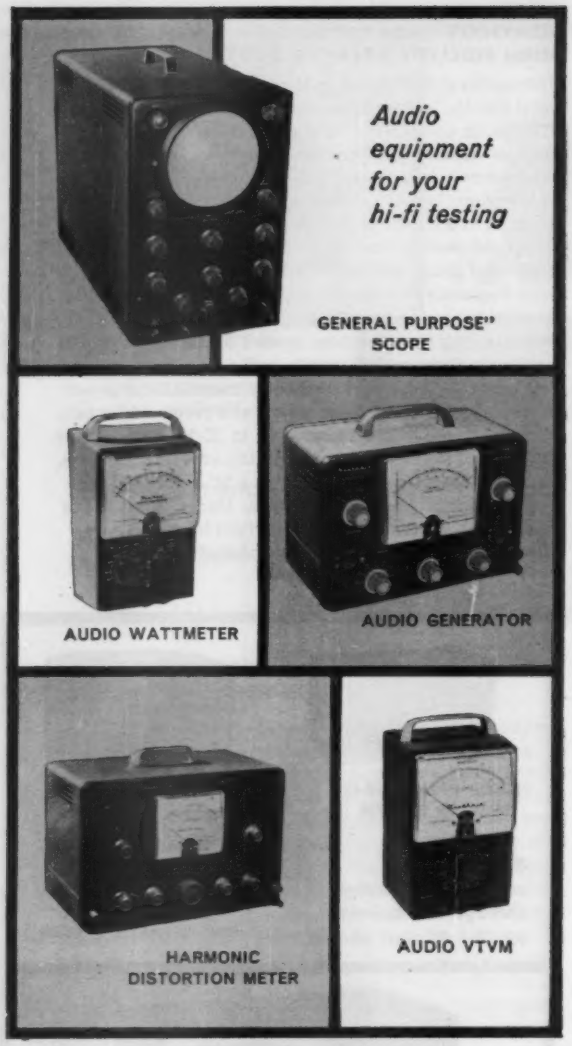
HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, ¾" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22¼" D x 34" H.

Choice of two beautiful cabinets. Model HH-1-C in imported white birch for light finishes, and HH-1-CM in African mahogany for dark finishes. Shpg. Wt. 195 lbs.

MODEL HH-1-C
MODEL HH-1-CM
$325.00
EACH

"BASIC RANGE" HI-FI SPEAKER SYSTEM
Superlative sound reproduction through the speaker system of your choice
"RANGE EXTENDING" HI-FI SPEAKER SYSTEM
"LEGATO" HI-FI SPEAKER SYSTEM
SINE-SQUARE GENERATOR
AUDIO ANALYZER
Sine and square waves for countless applications.



HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch crt, and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2

$42.50

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover −10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1

$29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1,3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A

$34.50

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1

$49.50

Heathkits...

By DAYSTROM

are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3

$29.95

HEATHKIT COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs.

MODEL CD-1
$59.95

Heathkits...

By DAYSTROM

are guaranteed to meet or exceed advertised specifications

HEATHKIT TV ALIGNMENT GENERATOR KIT

This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs.

MODEL TS-4A
$49.50

HEATHKIT "EXTRA DUTY" 5" OSCILLOSCOPE KIT

This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a 5UP1 CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within +1.5 and −5 db from 3 CPS to 5 MC. Response at 3.58 MC down only 2.2 db. Sensitivity is 0.025 volts RMS/inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in an oscilloscope of this type. Shpg. Wt. 21 lbs.

MODEL O-11
$69.50

HEATHKIT ELECTRONIC SWITCH KIT

A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ±1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs.

MODEL S-3
$21.95

HEATHKIT VOLTAGE CALIBRATOR KIT

This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurment of unknown signal amplitude by comparing it to the known output of the VC-3 on oscilloscope. Shpg. Wt. 4 lbs.

MODEL VC-3
$12.50

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT TUBE CHECKER KIT

Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorted elements, open elements, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multicolor "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2

$29.50

HEATHKIT HANDITESTER KIT

The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. Measures AC or DC voltage at 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Slips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1

$17.95

HEATHKIT PICTURE TUBE CHECKER KIT

The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or cartons if desired. Checks cathode emission, beam current, shorted elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadowgraph" test. Permanent test cable with CRT socket and anode connector. No tubes to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1

$24.95

HEATHKIT ETCHED-CIRCUIT VTVM KIT

This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The V7-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7 lbs.

MODEL V7-A

$24.50

Heathkits...

By DAYSTROM

let you fill your exact needs from a wide variety of instruments

HEATHKIT 20,000 OHMS/VOLT VOM KIT

This fine instrument provides a total of 25 meter ranges on its two-color scale. It employes a 50 ua 4½" meter, and features 1% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers −10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 6 lbs.

MODEL MM-1

$29.95

TUBE CHECKER
High quality test gear you will be proud to own
ETCHED CIRCUIT VTVM
Priced low to fit your budget
HANDITESTER
PICTURE TUBE CHECKER
20,000 OHMS/VOLT VOM

HEATHKIT RF SIGNAL GENERATOR KIT

Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8

$19.50

HEATHKIT LABORATORY RF GENERATOR KIT

Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1

$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT

Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1

$29.50

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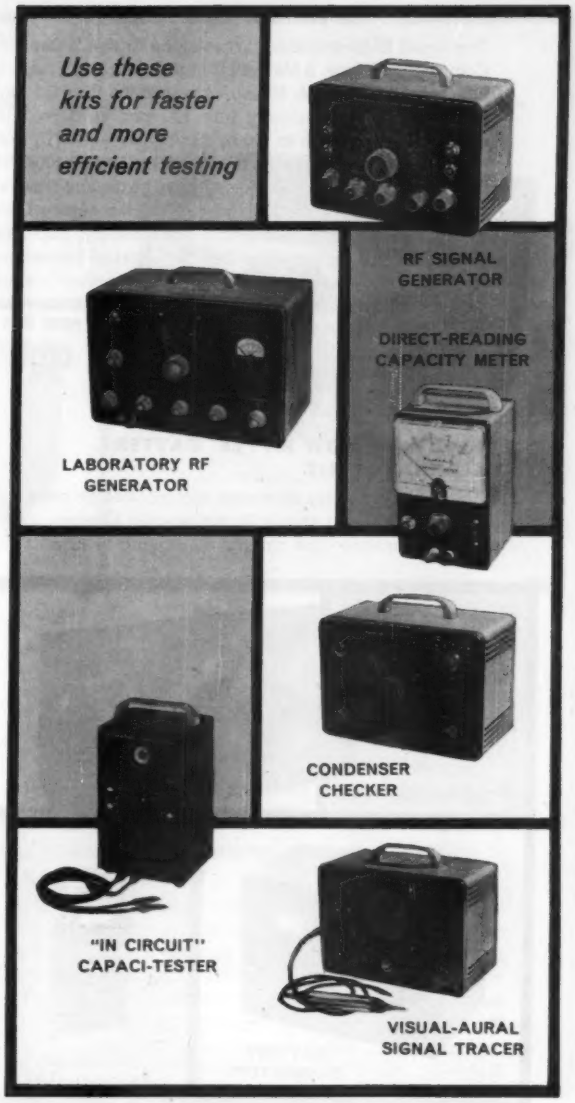
are educational as well as functional

HEATHKIT "IN-CIRCUIT" CAPACI-TESTER KIT

With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1

$7.95



HEATHKIT CONDENSER CHECKER KIT

This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3

$19.50

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and /or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3

$23.50

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

MODEL IB-2A

$59.50

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than .3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

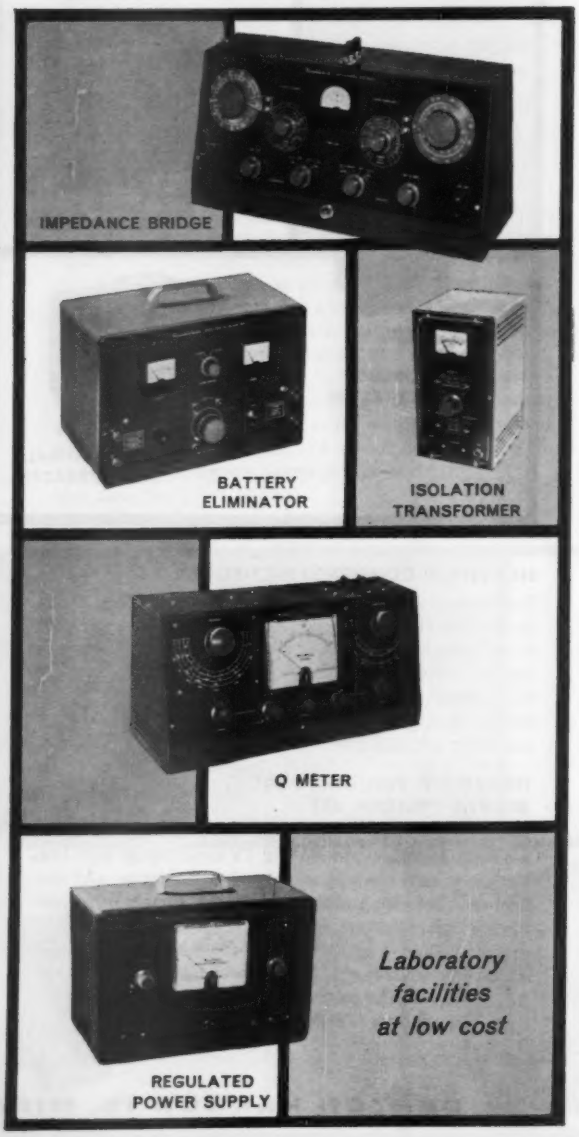
$39.95

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

$16.50



Heathkits...

By DAYSTROM

are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 milihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf ± 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed, compile data for coil winding purposes, or measure RF resistance. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

$44.50

HEATHKIT REGULATED POWER SUPPLY KIT

Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filaments. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

$35.50

Terrific values in amateur equipment!

DX-100 TRANSMITTER

DX-20 TRANSMITTER

DX-40 TRANSMITTER

HEATHKIT DX-20 CW TRANSMITTER KIT

The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DQ6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

MODEL DX-20

$35.95

Heathkits...

By DAYSTROM

are designed by licensed ham-engineers, especially for you

HEATHKIT DX-40 PHONE AND CW TRANSMITTER KIT

A most remarkable power package for the price, the new DX-40 provides both phone and CW facilities for operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 75 watt plate power input on CW, or control carrier modulation peaks up to 60 watts for phone operation. Modulator and power supplies are built right in and single knob bandswitching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. A 4-position switch provides convenient selection of three different crystals or a jack for external VFO. The crystals are reached through access door at rear of cabinet. You can build this rig yourself and be proud to show it off to your fellow hams. Get your DX-40 now for many hours of operating enjoyment. Shpg. Wt. 25 lbs.

MODEL DX-40

$64.95

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT

Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

MODEL DX-100

$189.50

FUNCTIONAL DESIGN . . .

The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

Automatically turns off transmitter and gives visual signal

"AUTOMATIC" CONELRAD ALARM

GRID DIP METER

"Q" MULTIPLIER

COMMUNICATIONS-TYPE RECEIVER

An ideal receiver for the beginning ham or short wave listener

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT

This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

MODEL CA-1
$13.95

HEATHKIT "Q" MULTIPLIER KIT

The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

MODEL QF-1
$9.95

HEATHKIT GRID DIP METER KIT

A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.00

MODEL GD-1B
$21.95

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT

This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

MODEL AR-3
$29.95
(Less cabinet)

Heathkits...

By DAYSTROM

are outstanding in performance and dollar value

HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2

$15.95

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 miliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1

$19.50

Heathkits...

By DAYSTROM

are the answer for your electronics hobby.

HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1

$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 miliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT MODEL VP-1-6
12 VOLT MODEL VP-1-12

$7.95 Each

REFLECTED POWER METER
Insure your "on the air" performance with these fine accessories.
VARIABLE FREQUENCY OSCILLATOR
VIBRATOR POWER SUPPLY
BALUN COIL SET

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The wave form produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed, and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1
$59.95

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-.02, .1, 1 and 10 miliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1
$79.95

Heathkits...

By DAYSTROM

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1
$11.50

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-weak-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1
$8.50

CRYSTAL RADIO
Now you can have radio wherever you go— with the portable that plays anywhere!
BROADCAST BAND RADIO
TRANSISTOR PORTABLE

HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

MODEL CR-1
$7.95

Heathkits...

By DAYSTROM

are easy and fun to build, and they let you learn by "doing-it-yourself"

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3¼" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

MODEL XR-1
$34.95
(Less batteries)
(With cabinet)

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5½" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. $4.95.

MODEL BR-2
$18.95
(Less cabinet)

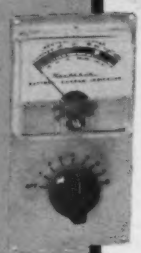
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

protects against possible explosion and fire from undetected fuel vapor

FUEL VAPOR DETECTOR

detects electrolysis currents which cause deterioration of underwater metal fittings on your boat

ELECTROLYSIS DETECTOR



indicates condition and charge of batteries for safe cruising

BATTERY CHARGE INDICATOR

R.F. POWER METER

HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

6 volt MODEL FD-1-6
12 volt MODEL FD-1-12
$35.95 EACH

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8"W x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

MODEL CI-1
$16.95

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

MODEL ED-1
$9.95

HEATHKIT RF POWER METER KIT

The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3¼" W x 6¼" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

MODEL PM-1
$14.95

Heathkits...

By DAYSTROM

now offer you completely modern marine equipment with outstanding design features

HEATHKIT TRANSISTOR RADIO DIRECTION FINDER KIT

The Heathkit Transistor Radio Direction Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit). The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5¾" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 5 lbs.

MODEL DF-1

$54.95

TRANSISTOR
RADIO DIRECTION FINDER

Heathkits...

By DAYSTROM

are sold only by direct mail, passing middleman profits on to you

Pioneer in "do-it-yourself" electronics

HOW CAN YOU MISS?

The Heath Company maintains a technical consultation service, should you experience some sort of difficulty in construction or operation. Although only a very small percentage of our customers ever have occasion to use this service (usually only beginners in electronics) it is still reassuring to know that technical help is available when needed. A service department is also available, should you wish a complete factory check of operation and alignment or repair. After you build your first Heathkit you'll realize how easy it is.

Free Catalog

Send for this informative booklet listing more than 100 "do-it-yourself" kits.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

ORDER BLANK

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Please ship C.O.D. ( ) postage enclosed for_____pounds.

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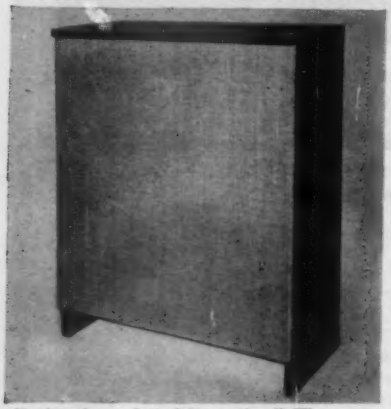
Hi-Fi-Audio Product Review

HARTLEY "LINEAR" SPEAKER

Hartley Products Company, 521 E. 162nd St., New York 51, N. Y., announces the availability of a new speaker system, the "Luth Holton," which incorporates an entirely new 220 speaker as the driving force.

According to the company, the new unit produces linear sound with virtual



elimination of "white noise." The system is housed in a natural wood enclosure which is available in various finishes. The speaker has a molded plastic basket which adds a modern look to the advantages of a non-magnetic mounting. The company's "tri-polymer" cone is also featured. The response of the speaker is said to be from 1 to 18,000 cps. Peak power capacity is 20 watts and inputs are 4 to 8 ohms.

"G.I. SPECIAL"

Components Corporation of Denville, N. J., has announced the availability of the "G.I. Special" turntable, designed specifically to meet the needs of Armed Forces personnel who are located in areas served by 50-cps power.

Either 50- or 60-cycle operation is obtained by merely shifting the belt to the appropriate step on the turntable's specially designed pulley. The unit is available for 33⅓-rpm operation.

20-WATT AMP-PREAMP

Altec Lansing Corporation, Anaheim, Calif., is offering a 20-watt power amplifier and preamp as one of the featured units in its line for 1958.

Tradenamed the "Quartet 344A," the circuit incorporates four independent volume controls; a printed circuit with all components attached through riveted eyelets; and six inputs, three low-level for magnetic phono pickup, microphone, and tape deck and three high level for tuner, tape reproducer, and spare.

Frequency response is 20 to 22,000 cps; 20 watts output with 40 watts peak; 138 db gain, 32 db bass control range, and 35 db treble tone control range. The unit measures 5$\frac{5}{16}$" x 14$\frac{5}{8}$" x 8$\frac{13}{16}$" with cabinet.

"AUDIOMATIC" PLAYER

Thorens Co., New Hyde Park, N. Y., has developed a unit which offers the convenience of a changer with the precision of a turntable. The unit is being marketed as the "Audiomatic" push-button player.

The Model CBA-83 carries a full year guarantee, has a direct-drive motor and adjustable speed control, push-button automatic arm action and finger-tip reject operation, completely foolproof mechanism, muting switch and tracking weight adjustment screw, manual operation, 50/60 cps, 100/250 volt operation, and full 12" turntable.

The base plate is 12" x 15" with 3¼" clearance required below the plate and 3" above. The company will supply additional details on request.

HEAVY-DUTY TAPE DEGAUSSER

Designed for both the professional and the serious home recordist, the new "710" heavy-duty degausser just introduced by *Aerovox Corp.* of New

Bedford, Mass. will erase magnetic tape without the necessity of rewinding.

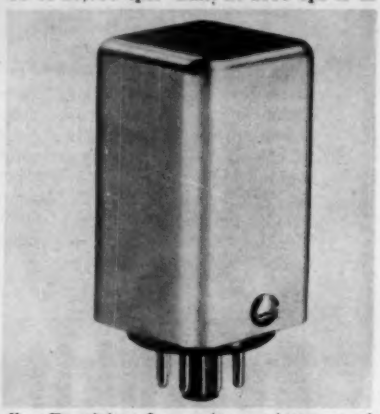
Demagnetization is accomplished quickly and simply by placing the tape over the spindle provided and rotating the reel three or four times until every portion of the tape has been exposed to the field area which exists within the rectangle outlined on the top of the unit. Continuing the rotation, the reel is slowly lifted off the spindle to a height of approximately 6 to 8 inches and the power is then turned off. This enables the tape to reach zero magnetization.

The unit is designed to be used with 117-volt, 60-cycle power sources. It will handle all 7" and 10" spools as well as smaller reels. The company's parts distributors are handling the item.

MAGNETIC TAPE PREAMP

EV Instruments, a division of *Electro-Voice, Inc.,* Buchanan, Mich., is now offering a three-stage transistor amplifier, the Model 6010, designed for playback use with magnetic tape heads.

The new unit compensates to the standard NARTB curve ± .7 db from 20 to 20,000 cps. Gain at 1000 cps is 42



db. Precision low-noise resistors and selected transistors assure unusually low noise output of 400 microvolts, unweighted. The maximum output is 1.5 volts r.m.s.; the input impedance is 40,000 ohms; output impedance is 15,000 ohms; and operating temperature a maximum of 40 degrees C.

The unit is packaged in a 1⅜"x1⅜"x 2⅝" aluminum can provided with an octal base for ease of installation. The power required is 6 volts at 1 ma.

GRILLE CLOTH SPECIAL

General Cement Mfg. Co., 400 S. Wyman St., Rockford, Ill., is now making a special offer to dealers covering its line of new and modern grille cloth material.

The grille cloth comes in pieces one yard long and 50 inches wide, providing more than enough for the average application. The pieces are individually packaged, with a wide choice of patterns and shades available to match almost any type of hi-fi, radio, or TV cabinet now being marketed. Light wood and plastic cabinets have been included and there are colors and styles to match them as well.

A wire display rack is offered with an order of 100 packages. Write the company for details on the special price.

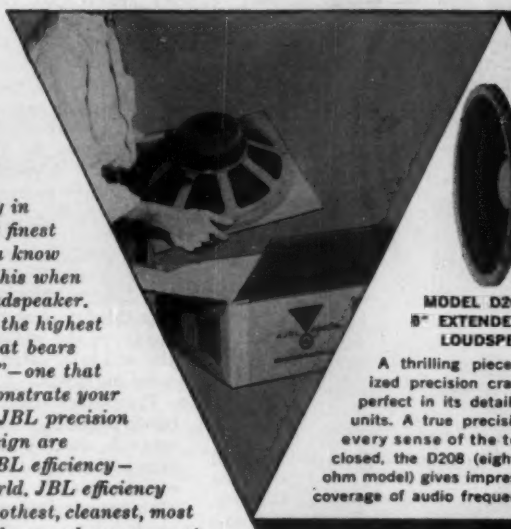
IN-LINE RECORDING HEAD

Nortronics Company, 1015 S. Sixth St., Minneapolis 4, Minn., has announced the development of a new in-line recording head, the Model TLD-S.

Developed for high-fidelity recording and reproduction in stereo and monaural applications, a new interchannel magnetic shield provides a high degree of crosstalk rejection. The head can be compensated to provide flat response between 30 and 10,000 cps. It is compact in construction, has precise gap alignment, features long life, and has negligible tape oxide accumulation.

make the most of your work... use a high precision **JBL LOUDSPEAKER!**

You will put many hours into learning the fundamentals, and then the fine points of high fidelity. You will spend your time and energy freely in building the very finest sound system you know how. Remember this when choosing your loudspeaker. Get a speaker of the highest precision—one that bears the symbol "JBL"—one that is worthy to demonstrate your own best efforts. JBL precision and advanced design are responsible for JBL efficiency—highest in the world. JBL efficiency gives you the smoothest, cleanest, most realistically lifelike sound you can get.



MODEL D208/D216
8" EXTENDED RANGE LOUDSPEAKER

A thrilling piece of miniaturized precision craftsmanship. As perfect in its details as larger JBL units. A true precision transducer in every sense of the term. Properly enclosed, the D208 (eight ohms, D216 is 16 ohm model) gives impressive, rich, full range coverage of audio frequency range.

MODEL D123
12" EXTENDED RANGE LOUDSPEAKER

An outstanding value, the D123 at first glance is most unusual because of its shallow structure – only 3⅝". More unusual is the crisp, clean bass it generates. Listening will develop great respect for the D123's smooth response, excellent handling of transients, and pleasingly lucid highs.

MODEL D130 15" EXTENDED RANGE LOUDSPEAKER

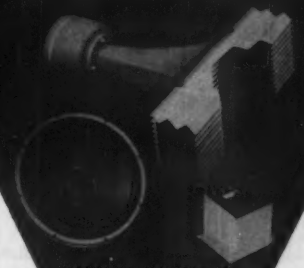
The only speaker of its kind... only one made with a 4" voice coil... only single unit speaker to give you complete, true high fidelity coverage of the entire audio spectrum. Your basic speaker. Use alone at first, later add JBL high frequency unit and dividing network for supreme excellence of JBL 2-way system.

MODEL 075 HIGH FREQUENCY UNIT

Exciting to behold, the precision-machined 075 embodies a new concept in high frequency reproduction. A ring, rather than a diaphragm, radiates sound energy into the annular throat of an aluminum exponentially tapered horn. Above 2500 cps, 075 sets a new standard for linear reproduction.

MODEL 175DLH HIGH FREQUENCY ASSEMBLY

The finest of high precision drivers designed for 1200 cycle crossover is combined with a machined exponential horn and acoustical lens for optimum sound reproduction in the home. The lens, an exclusive JBL development, acoustically illuminates a 90° solid angle with equal intensity regardless of frequency.



MODEL 086 KIT OF PROFESSIONAL COMPONENTS

The finest speaker complement made. Designed for theaters, used in the Hartsfield, available for other applications to industry and the serious high fidelity enthusiast.

JBL

Only a few of the many precision JBL products are shown on this page. Whatever your needs, you will find exactly the right system or unit for you in the complete, free JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

Please send me the following:

☐ **Free Catalog of JBL Signature Products**

☐ **Name and address of Authorized JBL Signature Audio Specialist in my community**

TECHNICAL BULLETINS ON:

☐ **D130** ☐ **D123** ☐ **D208**
☐ **175DLH** ☐ **075**

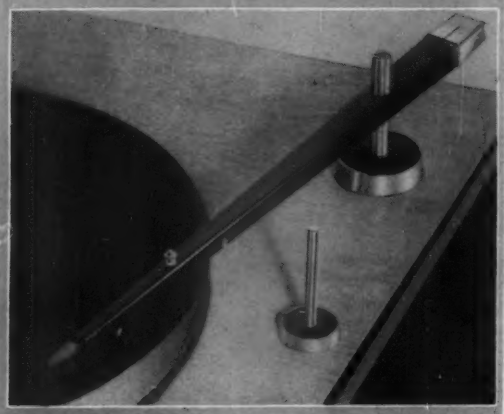
NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

***"JBL" means* JAMES B. LANSING SOUND, INC.** *3249 Casitas Avenue, Los Angeles 39, California*

NEW STANDARD OF PERFORMANCE



SHURE STUDIO Dynetic

PHONO REPRODUCER

REVOLUTIONARY DESIGN MAKES IT IMPOSSIBLE TO SCRATCH RECORDS!

IT TRACKS AT ONE GRAM! ITS FREQUENCY RESPONSE IS 20 TO 20,000 CPS (±2db)!

ONLY WITH THE STUDIO DYNETIC

- Record and needle wear are drastically reduced!
- You never have to level your turntable!
- You don't have to worry about groove-jumping!
- You can get superb fidelity, even from warped records!

You get the excellent response, low distortion and high compliance of dynamic cartridge construction, plus high output, minimum hum pick-up and the elimination of tone arm resonance and needle talk. There are also the additional benefits of the elimination of the pickup of low frequency rumble and motor noise. This superb unit sells for $79.50 net. Your hi-fi dealer will be happy to arrange a demonstration.

Write to Sales Department for reprints of informative, published articles.

SHURE *The Mark of Quality*

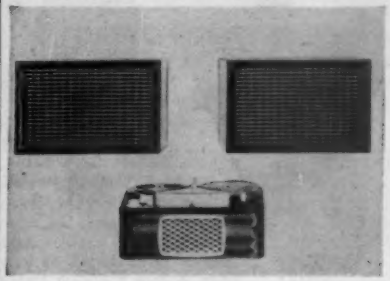
IN ELECTRONICS SINCE 1925

SHURE BROTHERS, INC., 210 HARTREY AVENUE, EVANSTON, ILL.

The Model TLD-S can be used in new equipment, for modernizing older recorders, for replacement, and for conversion.

STEREO TAPE SYSTEM

Tandberg, 10 E. 52nd St., New York, N. Y., is now offering a stereo tape system which consists of the Model 3-Stereo recorder/reproducer and two companion Model 266 speaker systems.



The recorder/reproducer has been designed to provide reproduction of both monaural and stereo tapes from 40 to 16,000 cps at speeds of 7½, 3¾, and 1⅞ ips. The unit will also handle complete monaural recording.

The matching speakers each contain one of the company's Model 165BK dual-cone wide-range 8" speaker units. The enclosures are finished on all four sides so that they can be used horizontally or vertically, depending on the individual room interior.

TWEETER DEMONSTRATOR

General Electric Company has issued a colorful, compact counter demonstrator which permits customers to hear how a *G-E* A1-404 tweeter improves hi-fi treble response in a single-cone speaker system.

The pre-assembled unit, including

tweeter and the company's A1-421 crossover network, is connected to the store's single-cone speaker system. A flip of the switch in the center of the unit cuts in the tweeter with its 1500 to 15,000 cps response.

The demonstrator is available from *G-E* Hi-Fi, Box 101, Liverpool, N. Y.

NEW MOVING COIL PICKUP

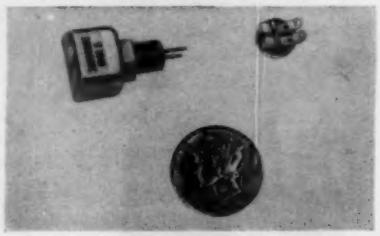
Electro-Sonic Laboratories, Inc., 35-54 Thirty-sixth St., Long Island City 6, N. Y. has developed a new moving coil pickup which incorporates the firm's patented d'Arsonval galvanometer principle and offers other improvements.

Designed to replace the company's "Concert Series" cartridge, the new unit offers improved mechanical rigidity and voltage output. Known as the Model C60, the cartridge can be used in any record changer or quality arm. Frequency response is 18 to 20,000 cps ± 1 db (*Elektra* 35 Test Record). Electrical output is at least five times greater than that of the "Concert Series" which means that no transformers or transistor amplifiers are required. Vertical stylus force is from 2 to 6 grams and output impedance is 40 ohms.

TAPE RECORDER HEADS

Sonotone Corporation of Elmsford, N. Y. has developed a new series of high-fidelity, low-priced tape recorder heads for the initial equipment market and will later offer them to the replacement market.

Frequency response of these new heads is 20 to 15,000 cps. The head presents a smooth, hard, and unbroken face to the tape resulting in a minimum of wear on the tape. The smooth face eliminates ridges or grooves in the tape



head that rub the oxide coating off the tape and cause it to pile up.

Although the heads are rugged and completely shielded, they are miniaturized. Currently available are record-reproduce heads, erase heads, and a dual record-reproduce-erase head.

NEW BEAM POWER TUBE

The Electron Tube Division of *Radio Corporation of America,* Harrison, N. J. has announced the development of a new 9-pin miniature beam power tube which has been designed especially for use as an output tube in high-fidelity audio equipment.

The 6973 features linear operation over a wide range of power, high power sensitivity, and high stability. These features in addition to low heater power (6.3 volts at 450 ma.) permit the design of compact, relatively low-cost audio equipment where high output voltage with low harmonic distortion is a primary consideration.

A technical bulletin giving complete specs on this new tube is available.

SCOTT AM-FM TUNER

H. H. Scott, 111 Powdermill Road, Maynard, Mass. is in production on a new medium-priced AM-FM tuner, the Model 300.

Completely new in styling, engineering, and performance, the unit's extreme simplicity makes it adaptable to any decor. The tuner incorporates the firm's exclusive wide-band FM detector which improves selectivity while the

circuit is drift-free without the need for a.f.c. Cross-modulation is minimized so strong local stations do not appear at several points on the dial.

The AM section features wide-range

circuitry and the smooth-acting slide rule dial is extra long for station separation.

The tuner measures 15½" x 5" x 12½" in its mahogany accessory case. Complete technical details and a free catalogue on this equipment are available from Department P of the company.

AUDIO MIXER

Miami Instrument Co., Box 384, Tamiami Station, Miami 44, Fla. has developed a versatile audio mixer for use with recording and p.a. systems.

The unit features plug-in transformers, preamplifiers, and line amplifiers. These plug-in units may be arranged to provide up to seven individually controlled input channels. Outputs of ± 20 dbm into 50, 250, or 600 ohms or up to 30 volts into high impedance may be obtained from the line amplifiers.

The inputs may be microphones, tape or disc players, tuners, etc. The mixer

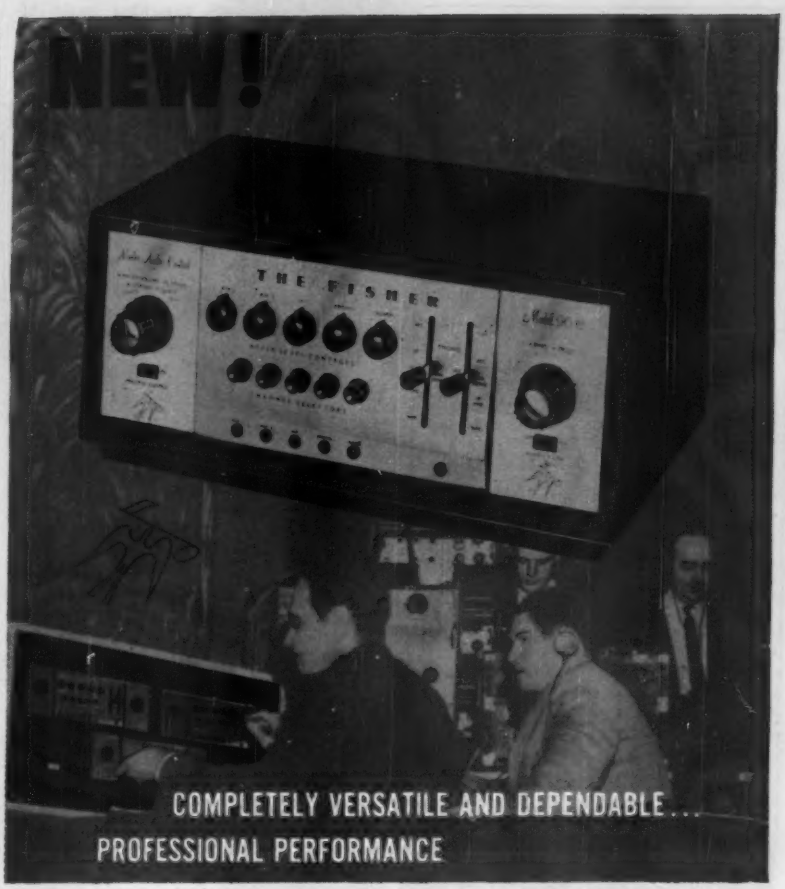
is available in rack mounting, sloping panel, or custom versions. All models are approximately 3½" high.

"ANNIVERSARY" TUNERS

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. has introduced two new "Anniversary Series" FM-AM tuners to the market.

The Models 90-R tuner and Model

90-T tuner and audio control center both incorporate the company's exclusive "Gold Cascode RF Amplifier" and companion circuitry. The "MicroRay



FOR YOUR HOME MUSIC SYSTEM

THE FISHER 90-C

Master Audio Control

NO TWO EARS hear music exactly alike. No two personal preferences in tonal balance are precisely the same, nor do the acoustical characteristics of any two surroundings duplicate each other exactly. The way the music sounds to YOU, *in your normal listening environment*, should be your most significant standard of performance. With THE FISHER MASTER AUDIO CONTROL, Model 90-C, you can achieve the tonal balance and color that suits *you* best. It will fully meet your personal, *as well as* the acoustic requirements, of the room in which it is used.

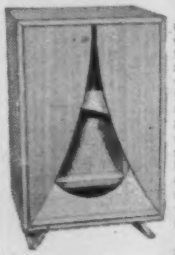
Among its many pace-setting electronic advances, THE FISHER Model 90-C includes a new PRESENCE CONTROL which brings solo instrument or vocal passages right out of the orchestral background. In addition, the 90-C offers a new, sharp-cut-off RUMBLE FILTER, to reduce low-frequency noise *with no discernible loss of frequency response*. With its facilities for mixing or fading from two to five channels, its Loudness Balance Control, its highly effective Bass and Treble Tone Controls, THE FISHER Model 90-C is by far the most versatile as well as the most comprehensive unit of its kind to be found anywhere! *Chassis*, $119.50

Mahogany or Blonde Cabinet, $9.95

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO • 21-23 44th DRIVE, LONG ISLAND CITY 1, N. Y.

A BOX IS NOT A MUSICAL INSTRUMENT



No skilled musical instrument maker, including even those in aboriginal tribes, has ever found a rectangular box satisfactory. **IN SPITE OF THIS,** today many HI-FI speaker systems proclaim the ultimate in high fidelity, yet they employ nothing more than the most elementary boxes to perform the complicated function of transforming the vibrations of the loudspeaker into sound.

In the **KARLSON ENCLOSURES,** specially curved internal and external structures are used to provide you with the highest performance capabilities available in the industry today. Actually the Karlson enclosure is one of the most fabulous musical instruments ever created and is capable of reproducing every sound from a baby's breath to the mighty roar of thunder. After long and rigorous tests, we know definitely that the Karlson Enclosures can outperform all other units now available on the market at any price.

Despite their fantastic performance characteristics these units are available to you in 20 different models in **KIT, UNFINISHED AND FINISHED FORMS,** at prices you can afford, ranging from $18.60 to $174.00.

SEND FOR OUR COMPLETE CATALOG TODAY AND LEARN HOW THE KARLSON ENCLOSURE CAN BE FITTED TO YOUR SPECIFIC NEEDS.

KARLSON ASSOCIATES, INC., Dept RTN8
1610 Neck Road
Brooklyn 29, New York

Please send catalog:

Name .....

Address .....

City .....State.....

SAVE ½ — PAY PART-BY-PART — HAVE FUN

Assembling the SCHOBER

ELECTRONIC ORGAN in KIT form

Now you can afford a real, full concert organ, just like those made by the foremost organ manufacturers. Because over ½ the cost is saved when you assemble it yourself. And it's REALLY EASY: only 24 separate units, all with printed circuits, and detailed-to-the-smallest-step instructions. In addition, you purchase each of the 24 kits when you are ready for it — and can afford it.

You'll get a real kick out of putting the Schober Electronic Organ* together — and then sitting down and pulling the stops for Strings, Trumpets, Clarinets, Diapasons, Flutes, etc. Electronic Percussion optional; chimes available.

Compact CONSOLE

One of the many exclusive features of this exceptional organ is the handsome console, in a wide variety of finishes. It is equally at home in a traditional or modern setting, and takes little more space than a spinet piano.

Free Literature

Complete descriptive booklet and price list are available on request. And, if you wish to hear the glorious pipe organ tone of the Schober Electronic Organ, a 10" long-playing demonstration recording is available for $2. This is refundable when you order. Write today and see what a fine instrument you can get at such a great saving.

The SCHOBER ORGAN CORP.

2248-R Broadway, New York 24, N. Y.

*Designed by Richard H. Dorf

Tuning Indicator" provides ease of tuning and great accuracy on weak signals. The push-button "FM Muting-AM Bandwidth" control eliminates inter-station noise and on-station side-response. Silver-plated shielding of the entire front end limits undesirable noise, interference, and radiation.

"KNIGHT" TAPE RECORDER

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has

added a tape recorder to its "Knight" line of audio equipment.

The Model KN-4010 is a dual speed unit with push-button controls, two built-in speakers and a "roving" speaker, an 8-watt push-pull amplifier, and a transistor preamp for minimum hum and noise.

Additional features include a handy digital index counter which permits the user to pinpoint any portion of a recording, an automatic shut-off which stops the machine the instant the tape is finished, high-frequency a.c. erase, and a special safety interlock which prevents accidental erasure of the tape.

The machine is housed in a charcoal gray case and will operate from any 110-120 volt, 60 cycle a.c. outlet.

EMC STEREO TAPE PLAYER

EMC Recordings Corporation, St. Paul, Minn. is now marketing a new stereophonic tape player which plays both stacked stereo and full track and dual track monaural tapes.

A feature of the stereophonic tape player is its simplicity of operation.

Only three knobs are used to control volume, tone, and balance. Beginners or those seeking an inexpensive stereo tape playing system can use the unit for one channel and a radio or television set for the second channel. One simple control regulates motor speed and handles tape start, stop, play, rewind, fast forward, and neutral.

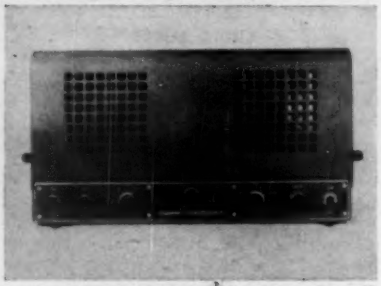
Tape speed is 7.5 ips. Wow and flutter is less than .25% with noise at least 50 db below 3% distorted signal. Frequency response is 40 to 12,000 cps ± 2 db and 30 to 15,000 cps ± 5 db. The unit is available complete or as a tape deck mechanism separately.

LABORATORY AMPLIFIER

Summit Electronics, Inc., 7 Industrial Place, Summit, N. J. has announced a new precision power amplifier for laboratory measurement applications or for home use in elaborate high-fidelity set-ups.

The Type 100 has been licensed by *Western Electric* and features exceptionally flat frequency response with unusually low harmonic and IM distortion. The noise and hum level are 70 db below full rated output of 30 watts.

Several models are available for varying input impedance requirements, with output impedance switch-con-



trolled from 4 to 600 ohms in all models. A carrying case is furnished with each amplifier.

"TAPE INDX"

Datrel Company of 520 Fifth Ave., New York 26, N. Y. has recently introduced a new product of interest to users of magnetic recording tapes.

Tradenamed "Tape-Indx," the new product permits the indexing of individual selections on a roll of tape. A tab is pressed on the exact spot to be identified for future use. The title is then recorded on a pressure sensitive label of corresponding number and color to the tab. This label is placed directly on the reel of tape or can be put on the tape box. It is also suggested that this information could be filed in permanent form in the company's special "Perma-File" which is a plastic wallet-size case.

The index tabs come in a package containing thirty items with complete instructions as to use included with each packet.

Those wishing further information on these handy units or data on prices and distribution should write direct to the manufacturer.

CABLES FOR AUDIO

Walsco Electronics Manufacturing Company, 100 W. Green St., Rockford, Ill., now has available a full line of shielded Tenite cables with molded-on connectors for use with hi-fi systems and sound equipment.

The cables are supplied in a wide range of lengths from 10" to 72" with various combinations of phono pin plugs and jacks, alligator clamps, spade lugs, and phone jacks. The molded construction of these units permits them to withstand severe strains and to outlast conventional soldered connections.

Bulletin No. FR3259 carries complete specifications on this new line. The booklet is available from parts distributors or from the manufacturer direct.

NEW "3M" RECORDING TAPE

Minnesota Mining and Manufacturing Co. of St. Paul, Minn. has announced a new "double play" magnetic tape which is said to be twice as strong as any other tape of its type.

Designated as the "Scotch" brand magnetic tape No. 200, it is made from durable polyester film which has been

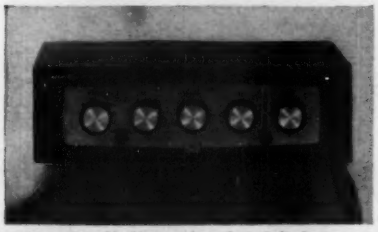
"tensilized" by a new process which doubles the strength of the conventional polyester film. Because of this new process, the tape can be used on any tape recorder without the danger of stretching or breaking.

The 7" reel, which contains 2400 feet of tape, is capable of four full hours of recording at 3.75 ips and two hours at 7.5 ips. The 10½ inch reel for special applications will record 16 hours at 1⅞ ips. This reel holds 4800 feet of tape.

20-WATT AMPLIFIER

The Specialty Electronic Components Dept. of *General Electric Co.*, Auburn, N. Y. is in production on a new 20-watt amplifier which retails in the moderate price class.

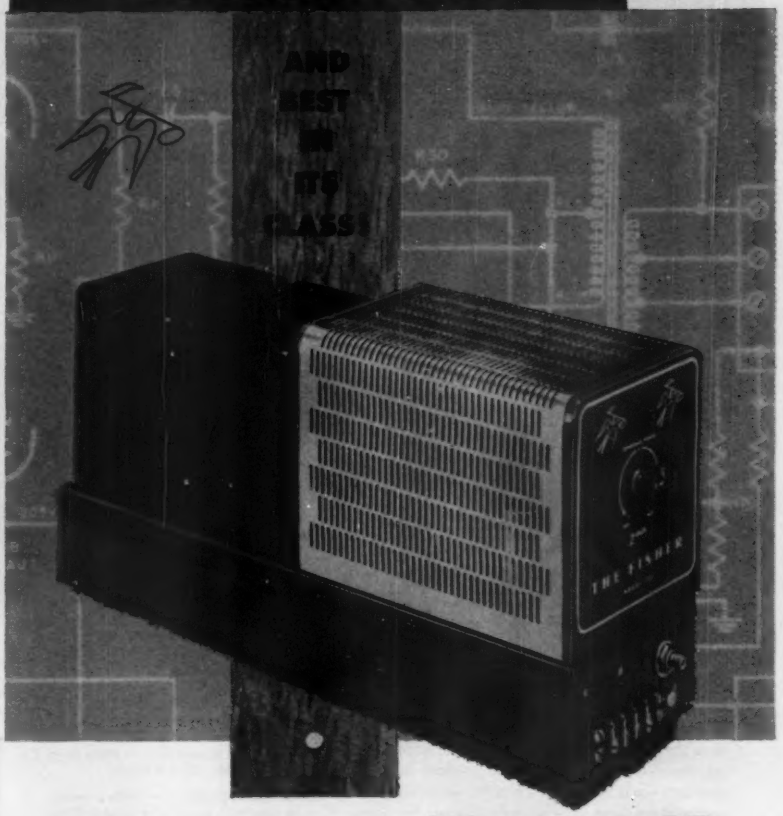
The Model PA-20 has a frequency response from 20 through 20,000 cps, a phono hum level of −60 db at full out-



put, over-all distortion level below audible perception, phono input sensitivity of 5 to 7 mv. at full output, and accurate phono equalization.

The amplifier incorporates an unusual *LC*-tuned circuit in its built-in rumble filter for a very sharp low-frequency cut-off of 12 db per octave below 40 cps. This effectively filters rumble and sub-audio frequencies with-

NEW FROM FISHER—



THE FISHER "100"

30 Watt Amplifier

FROM THE DRAWING BOARD, through every painstaking step of development and testing, to the proud accomplishment of the finished product, FISHER leadership is in evidence throughout! Now, FISHER announces a magnificent new power amplifier so outstanding in design, so superior in performance and so conservatively built that it will give you many years of "clean," trouble-free service.

HIGH POWER! *30 watts of power delivered to the speaker terminals in continuous sine-wave operation;* 70 watts of reserve peak power *to handle orchestral transients and peaks up to 30 milliseconds in duration, with no trace of clipping, ringing or raggedness.*

THE FISHER "100" has ample reserve power to drive even the lowest-efficiency loudspeaker system. Its absolutely clean tonal output eliminates listener fatigue and adds markedly to the enjoyment of your home music system. Hear it at your dealer *now!* **$99.50**

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO • 21-23 44th DRIVE, LONG ISLAND CITY 1, N. Y.

An audio system is like a chain. For optimum performance, all the links must be equally strong... there can be no compromise with "weak-link" components in the system.

It was on this premise that the Ampex A122-SP Portable Stereophonic System was designed. Each link in the chain — from recording and playback heads to speaker — was forged to the same exacting standards and precision tolerances which guide the manufacture of world-famous Ampex professional recording and playback equipment.

Heads — Facing surfaces of head gaps lapped to an optical flatness so precise they reflect a single light band (⅓ micron) on flatness gage. This, plus initial surface polish of 6-8 micro-inches, insures sustained frequency response with negligible change in characteristics over many thousands of hours of operation — many times longer than with ordinary heads.

Amplifier-Speakers — Ampex-designed, Ampex-built as an integral part of system . . . yet may be used separately with other units of your system (has front-panel input switching for Tape, Tuner, TV, or Phono). Amplifier sensitivity 0.25 v for maximum power output; 20-20,000 cps ± ½ db output with well under 1% harmonic distortion. Speaker features unusually high total gap energy, converts a maximum of output power into sound energy, with smooth, peak-free response.

Complete Specifications — Write today for free new full-color brochure containing complete specification sheet and description of full line of unmounted units consoles, modular table-tops and portables

AMPEX AUDIO, INC.
1044 KIFER ROAD,
SUNNYVALE, CALIFORNIA
Please send free full-color folder:

NAME

ADDRESS

CITY

college grads get ahead faster!

. . . have higher incomes . . . advance more rapidly. Grasp *your* chance for a better life. Share rewards awaiting college men. Important firms visit campus regularly to employ Tri-State College graduates. Start any quarter. *Approved for Vets.*

Bachelor of Science degree in 27 months

Complete Radio Engineering courses (TV, UHF, FM, Electronics). Also Mechanical, Civil, Electrical, Chemical, Aeronautical Engineering. *In 36-months a B.S. in Business Administration* (General Business, Accounting, Motor Transport Management). Superior students faster. More professional class hours. Small classes. Enrollment limited. Beautiful campus. Well-equipped labs. Prep courses. Enter Mar., June, Sept., Jan. Earnest capable students (whose time and budget require accelerated courses and modest costs) are invited to *write Jean McCarthy, Dir. Adm., for Catalog and book "Your Career in Engineering and Commerce."*

TRI-STATE COLLEGE
1618 College Ave. Angola, Indiana

TAPE RECORDERS
WHOLESALE PRICES
HI-FI COMPONENTS
NATIONAL BRANDS
WRITE FOR FREE CATALOGUE
CARSTON 215-RD E. 88 ST. NEW YORK 28, N. Y.

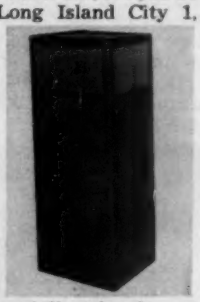
30 Watt Hi-Fi Super Lin Kit
AMP-PREAMP with TRANSISTORIZED FRONT END
FREQUENCY RESPONSE: ± 1 db 10-40,000 cps.
TUBES: uses (1) 6AU6, (1) 12AT7, (1) 12AU7, (2) EL34's, (1) 5V4-GB.
SHIPPING WEIGHT 26 lbs. FL-30
Sale Price.. **$42.00** F.O.B. N.Y.
Send for Free Catalogue
CUTICK ELECTRONICS HI-FI RADIO T.V. PARTS
171 Washington St., WOrth 2-5866, New York 7, N.Y.

out appreciable effect on bass response. The unit has interstage feedback phono compensation which gives low distortion and allows the use of practically all low and high input cartridges on the market.

The PA-20 has a compact, leather-grain finish cabinet only 4½ inches high, with extra-size knobs and a gold brushed escutcheon for compatibility with a wide range of tuner cabinets and furniture styling.

NEW EICO SPEAKER SYSTEM

Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. has released a new generic type of speaker system which has been designated as the HFS-2 standard speaker system.

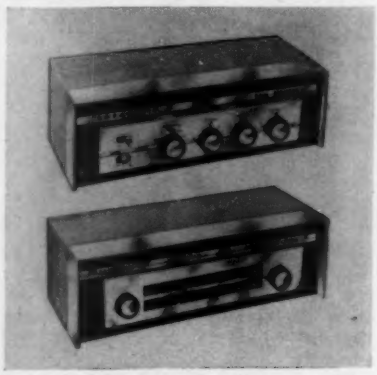


The system utilizes the new slot-loaded conical horn invented by A. Stewart Hegeman and a new omni-directional cone tweeter for extended radiation in all directions. The spectrum from 30 to 200 cps is handled by the slot-loaded split conical horn of 12 feet total length rear loading an 8½" driver, 200 to 6000 cps is produced by frontal radiation from the same 8½" driver, and the range from 6000 to 20,000 cps is handled by a separate coaxial mounted free-floating cone tweeter plus fixed inner loading cone mounted in the open above the horn mechanism box. The acoustical crossover is at 200 cps while the electrical crossover network is at 6000 cps. Rated impedance is 16 ohms.

The system is being offered in mahogany, walnut, and blonde birch finishes. The enclosure measures 36" x 15¼" x 11½". It weighs 45 pounds.

MATCHED TUNER-AMPLIFIER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering a custom hi-fi tuner and amplifier which



have been matched in style and performance.

Marketed as the "Music Mates" the amplifier uses the new premium quality EL84 tubes in push-pull and has a power output rating of 15 watts. Fre-

quency response is 20 to 20,000 cps ± .5 db and distortion is less than 1%. The new amplifier features separate bass, treble, volume, and loudness controls and has five input channels with tape and record equalization.

The companion AM-FM tuner features temperature-compensated circuitry and efficient a.f.c. action to minimize drift and lock in program material. An a.f.c. defeat switch is provided for tuning in weak stations. The Armstrong circuit with Foster-Seeley discriminator employs 6 tubes plus a matched pair of crystal diodes and rectifier. Built-in FM and AM antennas are said to provide excellent reception.

AUDIO CATALOGUES

LAFAYETTE COMPONENTS

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has just issued a single page flyer, ST-81, which describes its new master audio control center and stereo AM-FM tuner in some detail.

Each unit is pictured and complete specifications given. The control center is available in either kit or wired form while the tuner is available as a kit.

SCOTT HI-FI CATALOGUE

H. H. Scott, 111 Powdermill Rd., Maynard, Mass has just issued a two-color catalogue which pictures and describes the company's complete line of hi-fi equipment.

Included in the new publication are three amplifiers, five tuners, a turntable, and two power amplifiers. There are photographs showing how these components look in the home, including one taken in the music room of Metropolitan Opera star Jerome Hines.

The catalogue is available without charge on request.

"WIGO" SPEAKER CATALOGUE

United Audio Products, a division of *United Optical Manufacturing Corp.*, 202 E. 19th St., New York 3, N. Y. has just published a compact folder which describes its complete line of "Wigo" loudspeaker systems.

Ten models, including single- and dual-cone tweeters, 8" mid-range speakers, a 12" extended range speaker, a 12" coaxial-mounted system, and 12" and 16" woofers, are described in detail along with complete specifications.

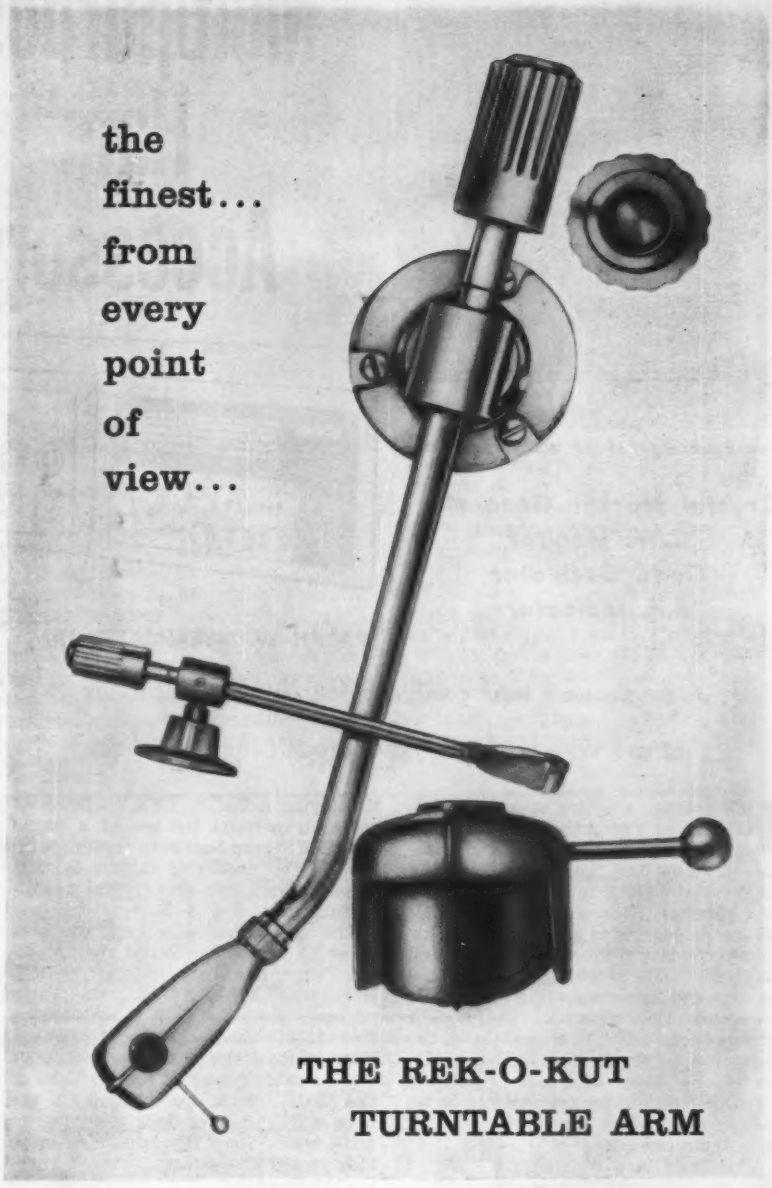
The company will supply a copy of this new catalogue free on request.

"CATHEDRAL SERIES" SPEAKERS

Cletron Inc., 1974 East 61st Street, Cleveland 3, Ohio has just released an elaborate 8-page catalogue which describes and pictures its new "Cathedral Series" of high-fidelity speakers.

The new line consists of 14 speakers and one three-speaker combination board with crossover network. Covered in some detail are woofers, full scale-wide range units, tweeters, and coaxial high-low duets with built-in crossovers.

The company will supply copies of this colorful catalogue on direct request. -30-



Most superbly styled of all arms — this is also the *one* turntable arm that offers best compliance, lowest resonance, optimum tracking . . . to give you better sound! That is why it is the *one* arm invariably sold with every turntable — *outselling all other turntable arms combined!* Write for catalog and free Strobe disc. $26.95 12" Arm, $29.95 16" Arm.

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Multipurpose Ham Accessory

Front-panel view of the multipurpose unit.

Crystal Marker Generator
C.W. Monitor
Code Oscillator
R.F. Indicator

By
RALPH W. MYERHOLTZ, JR.

A single unit that combines four useful operations that are very handy to have around the ham shack.

THE average amateur operating position is an unsightly and confusing array of connecting leads and chassis. Usually the ham begins with a fairly neat layout for the transmitter and receiver. However, it is not long before he decides to add a c.w. monitor or a secondary frequency standard and soon the table is cluttered with subchassis and interconnecting cables. To eliminate this situation, the author undertook to build, in a single unit, the most frequently needed station accessories. No direct connections are needed to either the transmitter or receiver, eliminating the necessity to dig into their circuitry.

Combined in a 6" x 6" x 6" cabinet are the following station accessories: (1) 100 kc. and 1000 kc. secondary frequency standards; (2) a c.w. monitor; (3) code practice oscillator; and (4) an r.f. indicator for transmitter tuning. While originally designed for home station operation; this is a handy gadget to have along on Field Day.

Although many hams find a 100 kc. secondary frequency standard to be adequate, it is a real advantage to have available a 1000 kc. signal as well since those 100 kc. whistles are mighty close together when you reach the ten-meter band! With a 1000 kc. signal, however, it is a cinch to first find a 1 mc. check point. Then by flipping switch S_3, the 100 kc. note is made available and it is easy to count the number of whistles to the desired calibration frequency. A second switch, S_2, permits the oscillator to be turned off when it is not needed. Employing a *Valpey* DFS dual-crystal assembly permits the use of a single trimmer to zero-beat both crystals with WWV. The oscillator circuit is that recommended by the crystal manufacturer.

The remaining functions are provided by a modification of the "Monitone" circuit given in the "ARRL Handbook." When r.f. from the transmitter is fed in at J_1, it is rectified by the 1N34 diode. Current flowing through R_2, develops sufficient negative bias to cause cut-off of the first half of the 12AU7. With this tube cut off, the neon-bulb oscillator will generate an audio tone. Since this is nothing more than an *RC* time-constant circuit, varying the resistance of R_4 will change the frequency of oscillation. This tone is then amplified by the second half of the 12AU7, then a 6AQ5 provides sufficient power to drive a miniature speaker.

This same circuit may be used as a code practice oscillator. If a key is inserted at J_2, closing the key contacts will place —12 volts on the grids of the first triode, causing it to cut off with resultant operation of the neon bulb oscillator. Since it is used only to provide bias, the life of the battery will be essentially its shelf life.

Turning S_1 to its other position causes the current from the rectified r.f. to pass through M_1. Potentiometer R_1 permits this current to be limited to prevent meter damage at high r.f. levels. This circuit actually functions like an untuned field-strength meter and provides a handy means of monitoring the amount of r.f. actually going into the transmitting antenna—a more reliable means than simply watching the final plate current during tune up. It works well on all bands through 10 meters. For reliable operation of this or the "Monitone" circuit above 20 meters, it may be necessary to ground the unit cabinet directly to the transmitter chassis.

Although an a.c.-d.c. power supply would have been less expensive, a transformer power supply was chosen for greater safety. For safety reasons, all equipment at the operating position should be grounded. With a transformer supply there is no chance of having a "hot" chassis because the power plug was inserted the wrong way.

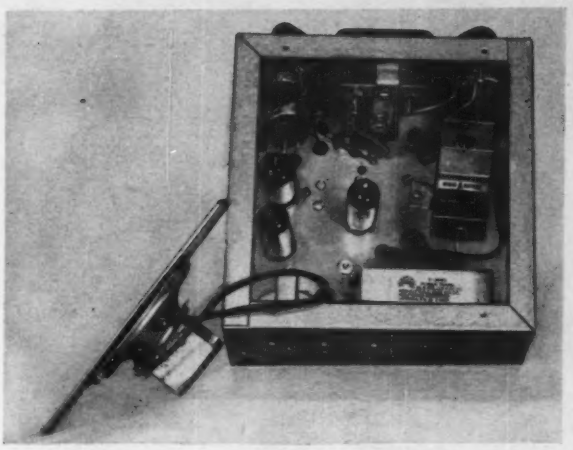
A 6" x 6" x 6" aluminum utility cabinet houses all of the components without undue crowding. Begin construction by mounting a sheet aluminum deck two inches from the bottom edge of the cabinet. Before fashioning the deck, the inside dimensions of the cabinet should be accurately measured in order to assure a snug fit. It will be necessary to file a shallow notch in two corners of the deck in order to clear overlapped portions of the cabinet sides. Before fastening the deck to the cabinet, be sure to scrape the paint from a portion of the inside of the cabinet to permit good electrical bonding between chassis and cabinet. Rubber grommets should be used to protect all leads passing through the chassis, as well as the power cord. It will be necessary to fashion a mounting strap for the two series-connected VSO68 batteries. Capacitor C_7 is most conveniently located just in front of the 6AK6 socket. The NE-2 is mounted between one outside terminal of R_4 and a nearby ground lug. Be sure to observe the po-

larity indicated in the schematic for the 1N34, the battery, and M_1. Note that the *positive* side of the meter is grounded. The circuit will fail to operate if the 1N34 diode is connected with reversed polarity.

For convenience the diode was mounted on a terminal strip fastened to the rear wall of the cabinet. Hold the diode leads with a pair of needle-nose pliers to prevent heat damage during soldering. Jacks J_1 and J_3 were mounted on either side of the rear wall to prevent the crystal oscillator from possibly causing operation of the monitor circuit. The dual-crystal assembly is mounted on one wall—the mounting strap providing the necessary ground connection. Be sure to remove the paint beneath this strap..

The speaker is mounted on the cabinet cover and a series of ¼" holes were drilled to permit passage of the sound. Finally, a series of ⅜" holes were drilled around the top edge of the cabinet to provide ventilation. The crystal is purposely mounted below the chassis to protect it from the heat of the tubes. As a finishing touch, application of decals to the panel will give the unit a "commercial" appearance.

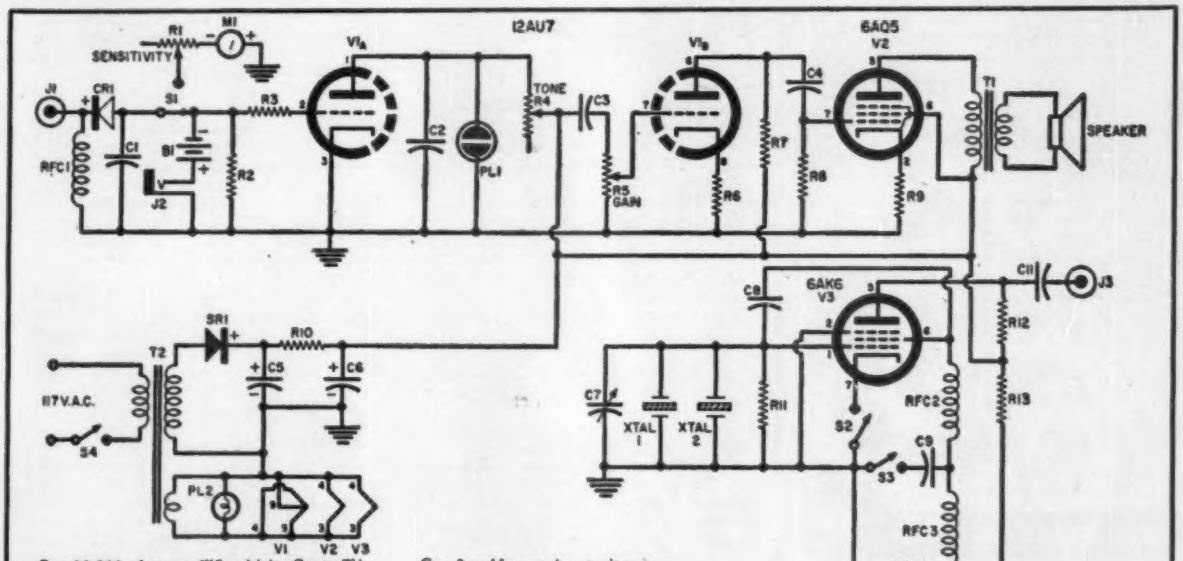
Using insulated wire, make several turns around the receiving antenna lead-in and plug it into J_3. Alternatively, this lead may simply be placed near the antenna terminal for the receiver. Run another insulated lead from J_1 to a place where it can pick up r.f. from the transmitting antenna. In some cases it is merely necessary to make a couple of turns around the lead-in. Some experimentation may be necessary to get the right amount of r.f. pickup. The chassis of the unit should be connected to the station ground system and, preferably, directly to the transmitter chassis.



Top view of unit showing speaker mounted on cover. Power and output transformers are to the rear of the chassis (bottom of photo). Battery B_1 is to the right. The selenium rectifier, dual crystals, and crystal trimmer are all beneath chassis.

To put the unit in operation, simply advance R_5 until the power switch clicks on. With S_1 in the "monitor" position, an audio tone should be heard when the transmitter key is depressed. Adjust R_4 for the most pleasing tone and the gain control for the proper volume. To use the unit as a code oscillator, simply plug a key into J_2 with S_1 in the "monitor" position. For transmitter tuning, S_1 must be in the "tune" position. Adjust R_1 for the proper meter deflection.

A simple adjustment is needed to tune the secondary frequency standard. Let the unit warm up for at least an hour and then tune your receiver to one of WWV's frequencies. Then carefully adjust C_7 until the oscillator zero-beats with the WWV signal. It may be desirable to repeat this adjustment after the components have aged after 15 to 20 hours of use. -30-



R_1—50,000 ohm pot ("Sensitivity Control")
R_2—1 megohm, ½ w. res.
R_3—68,000 ohm, ½ w. res.
R_4—5 megohm pot ("Tone Control")
R_5—1 megohm pot ("Gain Control")
R_6—1200 ohm, 2-watt res.
R_7—100,000 ohm, ½ w. res.
R_8—470,000 ohm, ½ w. res.
R_9—560 ohm, 1 w. res.
R_{10}—1000 ohm, 3 w. res.
R_{11}—4.7 megohm, ½ w. res.
R_{12}—470,000 ohm, 1 w. res.
R_{13}—2200 ohm, 1 w. res.
C_1—100 μμfd. ceramic capacitor
C_2—.001 μμfd. disc ceramic capacitor
C_3, C_4—.005 μfd., 600 v. capacitor
C_5, C_6—20/20 μfd., 250 v. elec. capacitor
C_7—25 μμfd. APC midget variable capacitor
C_8—3 μμfd. ceramic capacitor
C_9, C_{11}—.1 μfd., 400 v. capacitor
C_{10}—10 μμfd. ceramic capacitor
S_2—S.p.d.t. rotary switch
S_3, S_4—S.p.s.t. toggle switch
S_1—S.p.s.t. switch (on R_5)
T_1—Output trans., 5000 ohms to 3.2 ohm voice coil
T_2—Power trans. 120 v. @ 50 ma.; 6.3 v. @ 2 amps (Merit P-3045 or equiv.)
Speaker—3", 3.2 ohm speaker
M_1—0-1 ma. meter
Xtal. 1, Xtal. 2—100-1000 kc. dual crystal (Valpey DFS)
RFC_1—2.5 mhy. r.f. choke
RFC_2—.5 mhy. r.f. choke
RFC_3—5 mhy. r.f. choke
J_1, J_2—Amphenol Type 78 jack
J_3—Open circuit jack
PL_1—NE-2 neon lamp
PL_2—6.3 volt panel lamp
SR_1—65 ma. selenium rectifier
CR_1—1N34 crystal diode
B_1—12 volt battery (two RCA VS068 in series)
V_1—12AU7 tube
V_2—6AQ5 tube
V_3—6AK6 tube

Complete schematic diagram and the parts listing for the multipurpose accessory.

"Servicing TV Sync Systems"

by Jesse Dines

Valuable time-saving book for Service Technicians. Covers fully the theory of operation, circuit function and circuit variations of the 18 different types of sync systems used in TV receivers. Explains various types of sync separator, horizontal and vertical oscillator, and horizontal AFC circuits used in sync systems. Methods of analyzing and troubleshooting these circuits are supported by actual picture tube photos and waveforms illustrating types of sync troubles. Includes valuable data on oscillator coils, transformers and printed electronic circuits used in sync systems. Has chapter on practical servicing hints. This book will definitely help the technician to better understand and more easily service any type of sync system trouble. Written clearly and simply for quick and easy understanding. 320 pages; 221 illustrations, 5½ x 8½".

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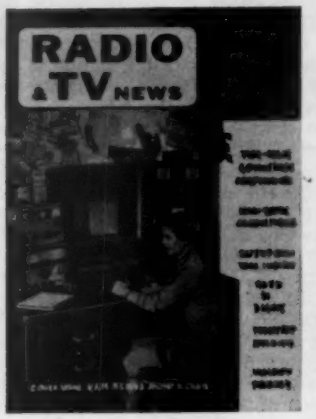
COVER STORY

MODERN HAM SHACK



World Radio Laboratories' ham shack is used for ham training, demonstration, and actual rag-chewing.

THE girl on our cover this month is Dorothy Hicks, KØBRZ, who lives in Omaha, Nebraska. Dorothy is shown operating at WRL's demonstration ham shack in Council Bluffs, Iowa. Although she would eventually like to have a home setup that is as elaborate as the one shown, Dorothy's home station is a little more modest—a Johnson Viking "Ranger," a WRL tri-band beam, and a National NC-300 receiver. She does most of her rag-chewing, usually about 3 hours' worth a day, on 10- and 15-meter phone.

Dorothy really comes from a hamming family. Her husband, Curt Hicks, is KØAMM. He is president of the Ak-Sar-Ben Radio Club and is very active in local Civil Defense affairs. Much of his hamming is with a mobile rig consisting of a 10-meter Subraco transmitter and a PMR-6 Multi-Elmac receiver. Paul, one of their two sons, received his Novice ticket when he was 11. His call is KNØGZJ.

Dorothy took her Novice and General Class training at World Radio Laboratories' code classes. Her son was also trained here. Novice training has been going on for the past several years. During last year, approximately 300 received their licenses and Leo Meyerson, head of WRL, expects that almost double this number will receive their licenses this year. As a matter of fact, the last group of trainees (some 86 in number) was so large that the group had to meet at one of the local schools for adequate room.

The ham shack shown on our cover has been set up for the convenience of customers who wish to keep a schedule while passing through or simply for them to keep up on their hobby by seeing and using the latest ham gear. Equipment is changed regularly so that over a period of a year, just about every manufacturer is represented. The ham shack is in operation for about two hours a day and it is also available to Novice operators who don't as yet have their own stations.

Equipment Used

In the setup shown, Dorothy is speaking into an Astatic D-104 crystal mike which is connected to the Hallicrafters HT-32 transmitter (center unit on desk). A Vibroplex bug is nearby for c.w. operation. The transmitter is being used here as a single-sideband exciter with its output suitably reduced by a power reducer network and applied to the r.f. section of the WRL "Globe King" 500B transmitter (at right). The power of this transmitter under single-sideband conditions is 720 watts peak envelope power input to the final. Since the 500B also contains its own exciter, v.f.o., and speech modulator sections, this unit may be used independent of the separate exciter shown here. As such, the "Globe King" may be used as a complete phone and c.w. transmitter with bandswitching provided from 10 through 160 meters. The plate power input is 540 watts on either phone or c.w.

The HT-32 exciter may also be used as a completely separate and independent lower power standby transmitter. This unit provides single-sideband, phone, or c.w. operation from 80 through 10 meters. The peak envelope power input is 144 watts.

The output of the high-power rig is fed to a high-gain 20-meter beam through an external antenna relay.

Atop the exciter unit are two loudspeakers which are connected to the two receivers at the left. The upper receiver is the Hammarlund HQ-110, a twelve-tube superhet with dual conversion. Full-dial coverage of the 6- to 160-meter amateur bands is provided. The receiver provides an Auto-Response feature that lowers the audio passband as the audio gain is increased. Thus the response to strong signals is broad band and to weak signals is narrow band. Other features include crystal-controlled second conversion oscillator, Q-multiplier, crystal calibrator, and separate linear detector for SSB.

The bottom receiver is the National NC-109, an eleven-tube general coverage unit tunable from 540 kc. to 40 mc. in four bands. A separate product detector is used for SSB and c.w. reception. A gang-tuned r.f. amplifier stage, plus two i.f. and two audio stages are used.

The idea of using a pair of receivers is so that a continuous civil defense monitor system can be employed. In this case then, the Hammarlund HQ-110 may be used as the amateur band receiver while the National NC-109 may be used as the monitoring receiver.

Tacked onto the wall behind the equipment are some of the large number of QSL cards from hams that have been worked from the station. Other cards are from the many hams who have just dropped in to operate the station or to say "hello."

(Cover Photo by G. C. Lucas)

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Model Y-787

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Only $4.99 down

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- Flywheel Tuning
- Automatic Frequency Control
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- Beautiful Custom-Styled "Space Saver" Case

The best-looking, best-performing FM-AM tuner kit your money can buy! Carefully designed for quick, easy construction—a tuner you'll enjoy assembling and be proud to own, both for its amazing musical performance and outstanding beauty. Covers the full AM broadcast band and 88 to 108 mc FM. On FM, *sensitivity is a remarkable 2.5 microvolts for 20 db of quieting;* hum and noise, –60 db; IF bandwidth, 200 kc at 50% down on curve; response, ± 0.5 db, 20-20,000 cps. On AM, *sensitivity is 3 microvolts for 10 db signal-to-noise ratio;* IF bandwidth, 8 kc at 50% down on curve; response, 20-8000 cps. Outstanding features include: Inertia Flywheel Tuning for effortless, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board (with most of the kit wiring already done for you) assures time-saving, error-free assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; rotatable built-in ferrite antenna for AM. Includes beautiful French-gray case with chrome-finished tapered feet, 4 x 13 x 8". Ideal for use with 18, 20 or 30 watt KNIGHT-KIT amplifiers. Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Tuner Kit. Net only.....**$49.95**

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- Printed Circuit Switches • Printed Circuit Boards
- 8 Inputs For Every Possible Signal Source
- Full 30 Watts Output • Custom-Styled Beauty

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Level Set control). Power amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts. Separate Bass and Treble controls; rumble filter switch; variable damping. Output, 8 and 16 ohms. With smart French-gray cabinet, 4 x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

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knight-kit High Fidelity FM Tuner Kit

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- Flywheel Tuning • Automatic Frequency Control
- Printed Circuit • Pre-Adjusted Coils and IF's
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Model Y-751. Hi-Fi FM Tuner Kit. Net only.....**$38.95**

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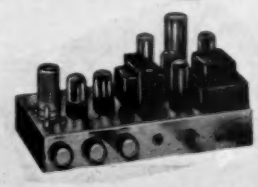
- Klipsch Designed and Licensed
- Famous Knight 12" 3-Way Speaker
- Easy to Assemble—Top Hi-Fi Quality
- Choice of Enclosure Finishes

Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT "Quik-Craft" corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—*no finishing required*—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12" woofer cone for bass (full 1¾ pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 12" 3-Way speaker, prefinished enclosure panels, grille cloth, hardware and instructions. *Specify Korina blonde, mahogany or walnut when ordering.* Shpg. wt., 44 lbs.

Model Y-937. 3-Way Speaker System Kit. Net only.....**$89.50**



knight-kit 10-Watt Hi-Fi Amplifier Kit

Y-753

$23.50

$2.35 down

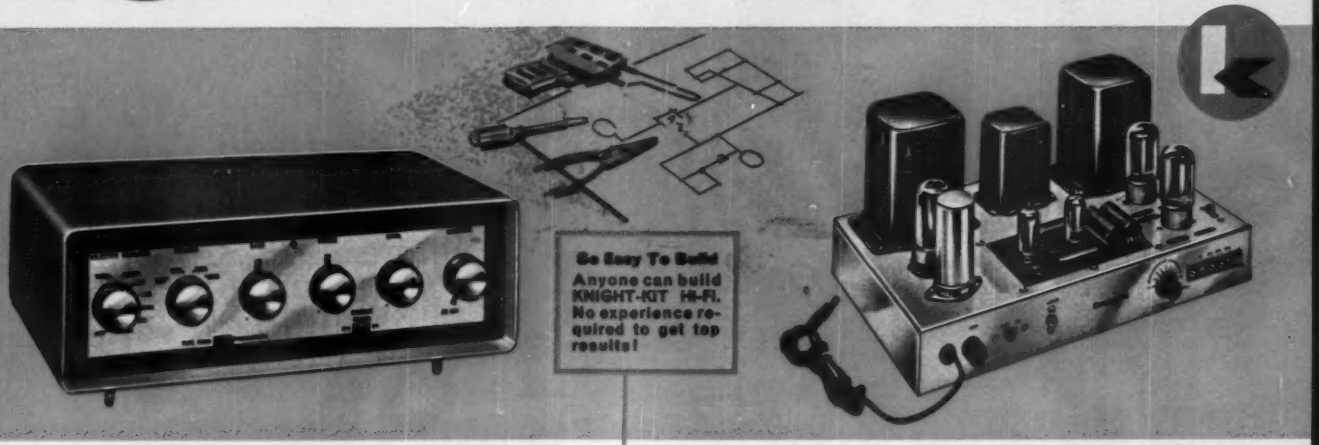
Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 30-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phono. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only 1% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6". With all parts, tubes and instructions. Shpg. wt., 13 lbs.

Model Y-753. Net only..**$23.50**
Y-235. Preamp Kit.....**$ 3.10**
Y-757. Metal Cover....**$ 3.95**

ALLIED RADIO *America's Pioneer in Electronic Kits*

knight-kits

THE VERY FINEST MUSICAL QUALITY—SO EASY TO-BUILD MONEY-SAVING HI-FI EVERYONE CAN AFFORD



knight-kit High Fidelity Preamplifier Kit

Model Y-754

$39.95

Only $3.99 down

- Exclusive Printed Circuit Switches and Boards
- Equalization ±½ db of Recommended Accuracy
- 8 Inputs Including Tape Head
- Self-Powered
- DC on All Tube Filaments
- Custom-Styled

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within ½ db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps. Includes exclusive new KNIGHT-KIT printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AY7 and ECC82 tubes. Frequency response, ± 0.5 db, 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phono; Pickering Phono; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preamplifier at the lowest possible cost. Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8". With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12½ lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only.....**$39.95**

knight-kit 25-Watt Hi-Fi Basic Amplifier Kit

Model Y-755

$44.50

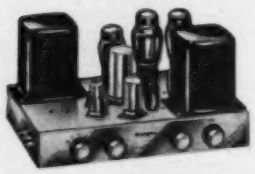
Only $4.45 down

- Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
- Only 0.15% Distortion at 30 Watts Output
- Printed Circuit Wiring Board • Chrome-Plated Chassis
- Williamson-Type Circuit with Over 25 Watts Output

Here's superb Hi-Fi performance at less than half the cost of a comparable commercially-assembled unit. Williamson-type linear-deluxe circuit delivers over 25 watts of virtually undistorted reproduction. Ideal for use with the KNIGHT-KIT preamp at left. Includes printed circuit board for simplified, error-free assembly. Remarkable hi-fi response, ± 0.5 db, 10-120,000 cps at 20 watts. Harmonic distortion, 0.15% at 30 watts; IM, 0.4% at 20 watts. Hum level, 85 db below 25 watts output. Output impedances, 4, 8 and 16 ohms; output tubes, 2-5881. Includes balance control for precise matching of the output tubes; variable damping control for maximum performance with any speaker system—prevents low-frequency distortion from overdamping or underdamping. Very attractive black and chrome styling, 6¼ x 14 x 9". An outstanding engineering achievement in a basic hi-fi amplifier, delivering performance equal to the finest commercially assembled units. Includes all parts and tubes; with step-by-step instructions, ready for easy assembly. Shpg wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only.....**$44.50**

Y-759. Metal Cover for above; black finish. 5 lbs. Net.....**$4.25**



knight-kit 20-Watt Hi-Fi Amplifier Kit

Y-750

$35.75

$3.57 down

True hi-fi for less! Complete with full set of controls and built-in preamplifier. Response, ± 1 db, 20-20,000 cps; distortion 1% at 20 watts. Inputs for magnetic phono, microphone, crystal phono or recorder, and tuner. Compensation positions for 78 and LP records. Separate bass and treble controls. Output impedances, 4, 8, 16 and 500 ohms. Chrome-plated chassis. 7 x 13 x 8¾". Ready for easy assembly. Shpg. wt., 20 lbs.

Model Y-750. Net only..**$35.75**

Y-758. Metal Cover.....**$4.15**

knight-kit 2-Way Hi-Fi Speaker System Kit

Model Y-789

$49.95

Only $4.99 down

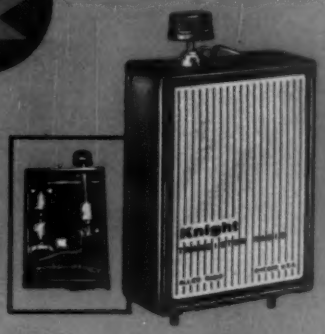
- Easy to Assemble—Pre-Finished Enclosure
- High Fidelity Response, 45 to 14,000 cps
- 12" Woofer and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

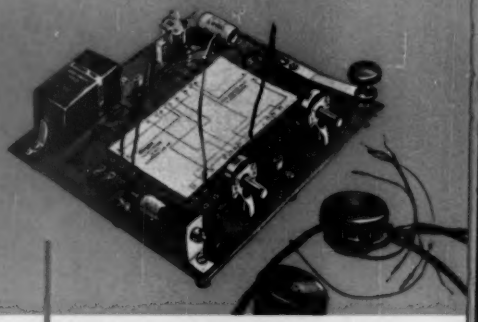
BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-way speaker system—it's quick and easy! The cabinet is *pre-finished* in full-grained, high luster blonde or mahogany—you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features "ducted port" construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 16 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 19 x 14". Beautifully styled to blend in any room. Kit includes Jensen 12" woofer, Jensen compression-type tweeter, pre-finished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. *Specify blonde or mahogany finish when ordering.* Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit.
Net only.....**$49.95**

knight-kit HI-FI IS AVAILABLE ON EASY TERMS TO FIT YOUR BUDGET

Fascinating ALLIED knight-kits FOR EXPERIMENTERS AND HOBBYISTS





knight-kit 2-Transistor Pocket Radio Receiver Kit

Model Y-262 $14.65

- Loud, Clear Local Reception
- Newest Printed Circuit Board
- Built-In Loop Antenna
- Complete Kit—Nothing Else To Buy

It's fun to build this pocket-size two-transistor radio—and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4x3¾x1¼". Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1½ lbs.

Model Y-262. Net only $14.65

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767 $2.45

Tiny, cigarette-pack-size one-transistor radio kit—fascinating to build—so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, compact case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.) Shpg. wt., 8 oz.

Model Y-767. Net only $2.45
J-149. 4000 Ohm Headphones. 1 lb. $2.15
C-100. Antenna Kit. 1½ lbs. $1.03

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299 $15.75

Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenter, student or hobbyist. Assemble basic parts once, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits; AM radio for strong headphone reception; 2-stage audio amplifier; wireless broadcaster; code practice oscillator; electronic timer; electronic switch; electronic flasher; photoelectronic relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.

Model Y-299. Net only $15.75

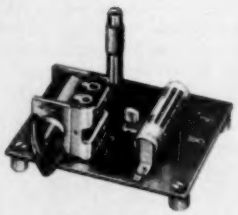
knight-kit 5-Transistor Superhet Personal Portable Radio Kit

Model Y-766 $29.95

- Styled to Equal the Finest
- Push-Pull Audio Drives 3½" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening. Provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½x3¾x1¾". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.

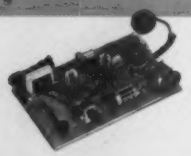
Model Y-766. Net only $29.95



1-Transistor Radio Kit

$3.95 Offers excellent AM local broadcast headphone reception. Printed circuit board for easy assembly. Operates from single penlight cell for months. Complete with all parts, transistor and penlight cell. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-765. Net only $3.95



"10-In-One" Electronic Lab Kit

$12.65 Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phono oscillator, code practice oscillator, signal tracer, relays, etc. Shpg. wt., 5 lbs.

Model Y-265. Net only $12.65

"6-In-One" Electronic Lab Kit

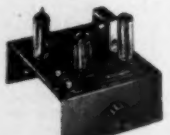
$8.45 A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcaster, etc. Shpg. wt., 3 lbs.

Model Y-770. Net only $8.45

Crystal Set Hobby Kit

$2.15 Entertaining, educational. Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-261. Net only $2.15



Wireless Broadcaster Kit

$9.50 Play music or make announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set. Shpg. wt., 3 lbs.

Model Y-705. Net only $9.50

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. · CHICAGO 80, ILL.

FUN TO BUILD . . . INSTRUCTIVE . . . LATEST CIRCUITS FOR TOP PERFORMANCE

WIDEST CHOICE OF QUALITY HOBBYIST KITS

knight-kit Photoelectronic Relay Kit

Model Y-702 $13.50

Advanced-design, ultra-sensitive photoelectronic relay—build it yourself and save! Dozens of uses: for automatic control of lights, door announcer, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "unseen" light (red filter) from Light Source Kit listed below. Selectable operation, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimes, counting devices, turning on lights at darkness). Has SPST relay operated from thyratron; 6.3 v. terminals provide power for accessories. For 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net only . . **$13.50**

Model Y-703. Light Source Kit. With bulb and red filter. Shpg. wt., 3½ lbs. Net . **$6.75**

knight-kit "Ocean Hopper" All-Wave Radio Kit

Model Y-740 $11.95

This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 kc to 35 mc, including every type of radio transmission: AM broadcast, marine, aircraft, distress channels, direction-finding, Amateur, frequency standard, foreign broadcast, and police. With bandspread tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. (Less extra coils, headphones, speaker and cabinet.) Shpg. wt., 5 lbs.

Model Y-740. Net only **$11.95**

Y-746. Cabinet for above. 1½ lbs. Net **$2.90**

Extra coils available: Long Wave Coil (155-470 kc), Net 79c. Short Wave (1.65—4.1 mc; 2.9—7.3 mc; 7—17.5 mc and 15.5—35 mc), Each 65c.

knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit

Model Y-243 $15.95

- Broadcast or Short Wave Reception
- Sensitive Regenerative Circuit
- Convenient Bandspread Tuning
- Built-In Loudspeaker

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch, being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police and marine radio on the 6.5 to 17 mc range, as well as standard 540-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. 7x10x6". Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. (Less cabinet.) Shpg. wt., 5 lbs.

Model Y-243. Net only **$15.95**

Y-247. Cabinet for above. Shpg. wt. 2 lbs. Net . **$2.90**

"Ranger II" Superhet Receiver Kit

$17.25

Popular Broadcast band receiver built and enjoyed by thousands. Features built-in antenna, automatic volume control, ball-bearing tuning condenser, PM dynamic speaker. Handsome plastic cabinet. Easy to assemble. AC or DC operation. Shpg. wt., 8 lbs.

Model Y-735. Net only **$17.25**

knight-kit 2-Way Intercom System Kit

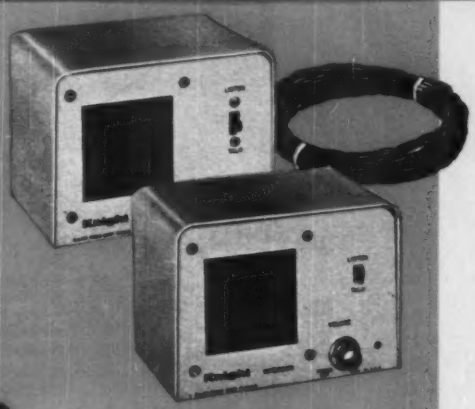
Model Y-295 $14.75

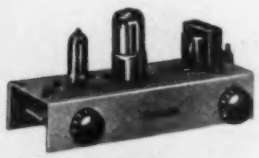
- Low Cost—Easy to Assemble
- High Gain—Clear Tone
- Handsome Metal Cabinets
- Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remote also may be set for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to even a whisper. Handsome Antique white cabinets, each 4¾x6½x4⅜". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., AC or DC. 8 lbs.

Model Y-295. Master and one Remote. Net only . . **$14.75**

Y-296. Extra Remote Station Kit. 3 lbs. **$3.75**





Phono Amplifier Kit

$9.45

Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and 3-4 ohm speaker. 1½ watts output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs.

Model Y-790. Net only **$9.45**

Electronic Photoflash Kit

$28.50

Ideal for color or black and white photography. 1/700th-of-a-second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. (Less battery.) Shpg. wt., 4 lbs.

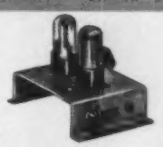
Model Y-244. Net only **$28.50**

Code Practice Oscillator Kit

$3.95

Ideal for beginners learning the code. Transistorized circuit. Operates for months from single penlight cell supplied. Clear, crisp 500 cycle tone. Jacks for headphones; screw terminals for key. 1 lb.

Model Y-239. Net only **$3.95**



Phono Oscillator Kit

$5.85

"Broadcasts" recorded music through any standard radio set up to 50 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs.

Model Y-760. Net only **$5.85**

FINEST ELECTRONIC EQUIPMENT IN EASY-TO-BUILD MONEY-SAVING KIT FORM

Better By Far— ALLIED knight-kit QUALITY TEST INSTRUMENTS

knight-kit Low-Cost Tube Tester Kit

Model Y-143 $29.75

- With 16 Filament Voltages
- 800 Latest Tube Types Listed
- Easy-to-Read 4½" Meter
- Tests Series-String TV Tubes

Expertly designed for complete, up-to-date coverage of tube types. Tests *series-string TV tubes;* tests 4, 5, 6 and 7 pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. Tests for open, short, leakage, heater continuity and performance (by amount of cathode emission). Big 4½" square meter has clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 16 filament voltages from 0.63 to 117 volts to check virtually all receiving tubes; blank socket for future type tubes. Universal-type selector switches permit selection of any combination of pin connections. Single-unit, pre-assembled 10-lever function switch simplifies and speeds assembly. Up-to-date illuminated roll chart lists over 600 tube types. Counter model case, 5 x 14 x 10". Easy to build. 14 lbs.

Model Y-143. Net only **$29.75**

Y-142. Portable Case model. 15 lbs. Net **$34.75**

Y-141. Picture Tube Adapter. 1 lb. Net ..... **$ 4.25**

knight-kit RF Signal Generator Kit

Model Y-145 $19.75

Build this wide-range, extremely stable RF signal generator—save two-thirds the cost of a comparable wired instrument! Large, semi-circular dial is clearly calibrated; range is covered in 5 separate bands for close accuracy in setting individual frequencies. Ideal for aligning RF and IF stages in radio and TV sets and for troubleshooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 112 mc; useful harmonics to 224 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit. Convenient jack for external modulation. Maximum audio output 10 volts; RF output over 0.1 volt on all ranges. Step and continuous-type attenuator controls. Supplied with precision-wound coils that require no adjustment. 7 x 10 x 5". Shpg. wt., 11 lbs.

Model Y-145. Net only **$19.75**

knight-kit 1000 Ohms/Volt VOM Kit

Model Y-128 $16.95

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab or Amateur use. Large 4½", 400 microamp meter with separate scales for AC and DC voltage and current, decibels and resistance. *Uses 1% precision resistors;* has 3-position function switch and 12-position range switch. *38 ranges* include: AC, DC and output volts, 0-1-5-10-50-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg (center scale readings of 60, 150 and 1500 ohms); Current, AC or DC, 0-1-10-100 ma and 0-1 amp; Decibels, −20 to +69 in 6 ranges. Precision resistors are used as shunts and multipliers to assure exceptional accuracy of measurements. With all parts, battery, test leads and black bakelite case with convenient carrying handle, 6¾ x 5¼ x 3¾". A great value in an easy-to-build quality instrument. Shpg. wt., 2½ lbs.

Model Y-128. Net only **$16.95**

knight-kit Vacuum Tube Voltmeter Kit

Model Y-125 $24.95

- 200 μa Movement, 4½" Meter
- Includes AC, Peak-to-Peak
- Balanced-Bridge, Push-Pull Circuit
- 1% Film-Type Resistors

Top buy in an extremely stable, highly accurate VTVM. Easy to assemble—entire chassis is printed circuit board. Perfect for radio-TV service work, lab and Amateur use. Features low-leakage type switches; 1% film-type precision resistors; balanced-bridge, push-pull circuit (switch to any range without readjusting zero set); zero center scale and direct-reading db scale; polarity reversing switch. Ranges: Input Resistance, 11 megs; DC and AC rms, 0-1.5-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-1400-4000; Response, 30 cycles to 3 mc; Ohms, 0-1000-10K-100K and 0-1-10-100-1000 megs; db, −10 to +5. Includes all parts, tubes, battery, test leads and portable case, 7¾ x 5¼ x 4-⅛". Easy to assemble. Shpg. wt., 6 lbs.

Model Y-125. Net only **$24.95**

Y-126. Hi Voltage Probe; extends DC to 50,000 v. ..... **$ 4.75**

Y-127. Hi-Frequency Probe; extends AC to 250 mc. ..... **$ 3.45**

6V-12V Battery Eliminator Kit

$32.95 High current rating; continuously variable filtered output; delivers 15 amps at 6 volts, 10 amps at 12 volts. May be used as battery charger. Two meters provide simultaneous current and voltage readings. Shpg. wt., 18 lbs.

Model Y-129. Net only **$32.95**

Transistor Checker Kit

$8.50 Checks gain ratio of all types of transistors; checks germanium and silicon diodes; checks for continuity and shorts. A valuable instrument at very low cost. Easy to assemble. Shpg. wt., 2½ lbs.

Model Y-149. Net only **$8.50**

Flyback Checker Kit

$19.50 Checks condition of all types of horizontal output transformers and deflection yokes, as well as TV linearity and width coils. 4½" meter; widest range in its field. Shpg. wt., 6 lbs.

Model Y-118. Net only **$19.50**

Sweep Generator Kit

$43.75 Extreme linearity on a par with costly lab instruments; fundamentals to 250 mc; output flat within 1 db; electronic blanking. Easy, money-saving assembly. Shpg. wt., 16 lbs.

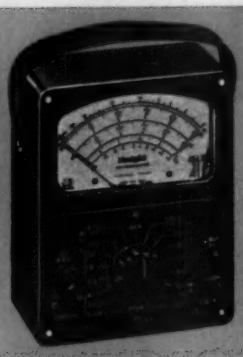
Model Y-123. Net only **$43.75**

Capacitor Checker Kit

$12.50 Tests capacitors while in the circuit! Has widest range—20 mmf to 2000 mfd. Exclusive circuit for cancelling lead capacity. "Magic Eye" indicator. Save 60% over factory-wired units. 5 lbs.

Model Y-119. Net only **$12.50**

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM



knight-kit 20,000 Ohms/Volt VOM Kit

Model Y-140 $29.50

Outstanding quality and performance at money-saving low price. Features 1% precision multipliers; 4½" meter accurate within 2% of full scale deflection; 50 microamp sensitivity for 20,000 ohms/volt input resistance on DC; front panel "Zero adjust"; single switch to select function and range. 32 ranges: AC, DC and output volts, 0-2.5-10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-0.1-10-100; DC amps, 0-1-10; Decibels, −30 to +63 in six ranges. Moisture-resistant film-type resistors for extreme accuracy. Carefully engineered circuit design achieves high sensitivity and extremely versatile application. Kit includes all parts, battery, test leads and black bakelite case with highly legible white markings; size 6¾ x 5¼ x 3¾". Easy to assemble. Shpg. wt., 5 lbs.

Model Y-140. Net only.....**$29.50**

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Model Y-135 $26.50

A remarkable value in an easy-to-build instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits. Has *highest gain in its price class.* Traces signal from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of *91,000;* "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; combination 2-position probe, one for RF (6 mmf. input), the other for audio. Provides noise test; built-in watt-meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Binding posts provide output transformer and speaker substitution test, plus external 280 volts B+. With all parts, tubes and probe. 7x10x5". 12 lbs.

Model Y-135. Net only.....**$26.50**

knight-kit 5" Wide-Band Oscilloscope Kit

Model Y-144 $69.00

Only $6.90 down

- 5 mc Width for Color TV
- Horizontal Sweep to 600 kc
- 25 mv/inch Sensitivity
- Z-Axis Input
- Printed Circuit Construction

Equals or betters the performance of commercially wired scopes costing far more. Two printed circuit boards and laced wiring harness assure wiring accuracy and cut assembly time. Ideal for lab use, color TV servicing and high frequency applications. Wide sweep range—*15 to 600,000 cps.* Vertical response, ± 3 db, 5 cps to 5 mc; only 1 db down at 3.58 mc color burst. High vertical sensitivity of .025 rms v/inch. Input capacity, 20 mmf. Outstanding features: cathode follower inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull amplifiers; positive and negative locking; frequency-compensated attenuator; Z-axis input; one volt P-P calibrating voltage; astigmatism control; retrace blanking circuit; DC positioning control. Includes CRT. 14⅓ x 9½ x 16". 40 lbs.

Model Y-144. Net only.....**$69.00**
Y-148. Demodulator Probe. Net.....**$ 3.45**
Y-147. Low Capacity Probe. 12 mmf. Net.....**$ 3.45**

Voltage Calibrator Kit

$12.75

Permits use of any scope as precision peak-to-peak AC voltmeter. Puts a true square-wave voltage on scope screen. Selects any voltage between .01 and 100 volts; feeds external signal direct to scope for instant comparison. Shpg. wt., 5 lbs.

Model Y-136. Net only.....**$12.75**

knight-kit 5" General-Purpose Scope Kit

Model Y-146 $42.00

Only $4.20 down

- Phantastron Linear Sweep
- 25 mv/inch Sensitivity
- Printed Circuit Board
- Retrace Blanking Circuit

Feature for feature the world's best oscilloscope kit value. A standout in its class with all these fine features: *Printed Circuit* wiring board and laced harness for quick, error-free assembly. *Phantastron Sweep Circuit* for high linearity of sweep from 15 to 150,000 cps. *25 Millivolts Per Inch Sensitivity*—3 times that of similarly priced scope kits. *Calibration Voltage*—1 volt peak-to-peak square wave, fully regulated. *Vertical Amplifier*—frequency response ± 3 db, 3 cps to 1.5 mc (± 6 db to 2.5 mc). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive and negative internal sync; high 2nd-anode voltage for high-intensity trace; input capacity, 45 mmf. Kit includes CRT. 9⅓ x 13¾ x 17¾". 26 lbs.

Model Y-146. Net only.....**$42.00**

Resistance Substitution Box

$5.95

Easily determines resistor values required in a circuit. Makes available 36 standard 1-watt resistance values in 2 ranges between 15 ohms and 10 megohms, with 10% accuracy. Slide switch selects range; 18-position switch for value selection. Shpg. wt., 2 lbs.

Model Y-139. Net only.....**$ 5.95**

Capacitance Substitution Box

$5.95

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard values from .0001 mfd to .22 mfd, ± 20%. All values are 600 volt, except .15 and .22, which are 400 volt. 18-position selector switch. Shpg. wt., 2 lbs.

Model Y-138. Net only.....**$ 5.95**

Audio Generator Kit

$31.50

Excellent design; range, 20 cps to 1 mc; less than .25% distortion; 600 ohm output. Ideal for hi-fi testing; offers the flat response of a lab standard. Shpg. wt., 16 lbs.

Model Y-137. Net only.....**$31.50**

R/C Tester Kit

$19.50

Measures capacitance and resistance. Balanced-bridge circuit; indicates power factor; tests capacitors at rated voltage. Large, easy-to-read dial and "magic eye." Shpg. wt., 10 lbs.

Model Y-124. Net only.....**$19.50**

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knight-kits FOR THE RADIO AMATEUR

knight-kit All-Band Amateur Receiver Kit

Model Y-726

$104.50

Only $10.45 down

- Tunes 540 kc to 31 mc
- Built-in Q-Multiplier
- Constant Running HF Oscillator
- Worthy of the Advanced Ham Operator
- Printed Circuit Bandswitch
- Printed Circuit Board
- 1.5 μv Sensitivity

A sensational communications receiver value with all the selectivity, sensitivity and features of high-priced commercial units. Uses printed circuitry throughout, including the exclusive new KNIGHT-KIT printed circuit bandswitch, for remarkably easy assembly. Covers 540 kc to 31 mc in 4 ranges; calibrated, electrical bandspread on 80-10 meter Ham bands; slug-tuned Hi-Q coils; continuous, VR tube-regulated B+ applied to HF oscillator lets you switch from standby to receive with no drift; built-in Q-multiplier peaks desired signal or nulls interference; delayed AVC; provision for crystal calibrator (below). Sensitivity, 1.5 microvolts for 10 db signal-to-noise ratio. Selectivity: variable from 300 cps to 4.5 kc at 6 db down. Exalted BFO injection. Controls: Main tuning, bandspread, band selector, Q-multiplier selectivity, Q-multiplier tune, null-off-peak, BFO pitch, RF gain, AF gain, BFO-MVC-AVC-ANL, off-stby-rec-cal, antenna trimmer, and phone jack. Cold-rolled 1/16" steel chassis. Handsome metal cabinet, 10 x 10 x 16½". (Less phones, 8-ohm loudspeaker and S-meter.) 23 lbs.

Model Y-726. Amateur Receiver Kit. Net..... **$104.50**

Y-727. S-Meter Kit for above. 1 lb. Net..... **$9.50**

knight-kit 50-Watt CW Transmitter Kit

Model Y-255

$38.95

Only $3.89 down

- Ideal for the Novice
- Pi Antenna Coupler
- Bandswitching—80 to 10 Meters

There's exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates at up to 60 watts on 80 and 40 meters. Oscillator is efficient 6AG7; final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pi coupler permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 8½ x 10½ x 8¼". With tubes and all parts for easy assembly. (Less crystal and key.) Shpg. wt., 19 lbs.

Model Y-255. 50-Watt Transmitter Kit. Net only..... **$38.95**

Model Y-725

$28.50

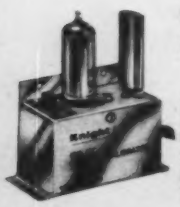
Only $2.85 down

knight-kit Self-Powered VFO Kit

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread; separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 8¼ x 6 x 6". Ready for easy assembly. Shpg. wt., 8 lbs.

Model Y-725. VFO Kit. Net only..... **$28.50**

knight-kit 100 Kc Crystal Calibrator Kit



Model Y-256

$10.50

Crystal frequency standard at very low cost. Gives marker every 100 kc up to 32 mc. A "must" for marking band edges. Mounting flanges for installation in or back of receiver cabinet. Size only 1⅝x 1⅝x3". Requires 6.3 v. at 0.15 amp and 150-300 v. DC at 3-6 ma. Trimmer for zero-beating with WWV; On-Off switch. Complete with tube, crystal, all parts and easy-to-follow instructions. Shpg. wt., 1 lb.

Model Y-256. 100 Kc Crystal Calibrator Kit. Net only..... **$10.50**

Model Y-253

$5.85

knight-kit Amateur RF "Z" Bridge Kit

Measures standing wave ratio (SWR) and impedance of antenna systems; ideal for adjusting antenna systems for optimum results. Measures impedances from 20 to 400 ohms up to 100 mc; SWR to 150 mc. Any VOM may be used for null indicator. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticised SWR chart (less meter). 2½ x 3 x 4½". Shpg. wt., 1½ lbs.

Model Y-253. "Z" Bridge Kit. Net only..... **$5.85**

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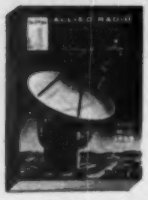

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Rhombic Antennas for TV

(*Continued from page 65*)

ditions, is the lower fading rate encountered with the addition of the second stack.

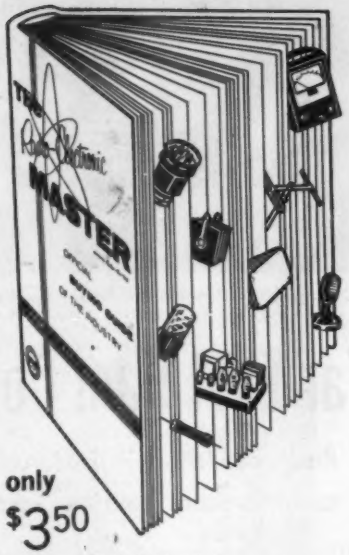
Signal fading at great distances from the transmitter location is a function of changing heat and humidity layers throughout our lower atmosphere. As they change, the signal strength will "shift layers" and, where it was strong a few seconds ago, become weak. Signals in the v.h.f. bands go over the horizon in layers, thin layers or relatively strong signals being interspersed with thicker layers of relatively weak signals. This effect shows up as fading. The second stack will be far enough away from the first so that, when layer shifts occur, at least one of the stacks is more likely to remain within the relatively strong signal layer a greater portion of the time than a single stack would.

A second stack will be identical to the first. The recommended distance between the two stacks (the stacking distance) may be obtained from line *SD* in Table 3. The two stacks are connected together by running a length of 450-ohm line, with a single twist, between them, putting them in parallel. (See Fig. 4.) The stacking distance should be maintained at all support poles and at all points between the two arrays.

The possibilities of the rhombic for relaying signal into valleys or other "pockets" where signal is absent are excellent. Some readers may recall cases, in the fairly recent past, in which low-lying communities have set up booster stations on mountaintops in order to re-radiate the signals available there to their homes. Unfortunately the FCC takes a dim view of such operations, classifying them as unauthorized transmitters and action was taken to close down these boosters.

There is a legal way of bringing signal into such locations, however, if a relay rhombic is used. The trick is to construct two identical rhombic antennas (two stacked units may be used, if the extra gain is required) connected and oriented as shown in Fig. 5. The pick-up unit is directed toward the transmitter(s) in the conventional manner. The second array, acting as a re-radiator, is then directed toward the area to be served. The two are then tied together with a length of 450-ohm or other suitable transmission line. If a valley is to be served from a greater height, the second rhombic should be pointed downward into the valley or else the narrow horizontal pattern in which it radiates may pass over the desired area altogether. The connecting length of line should be kept as short as is convenient.

Correctly designed and built rhombics, used in the ways described here, can widen the range of acceptable TV reception substantially. —30—



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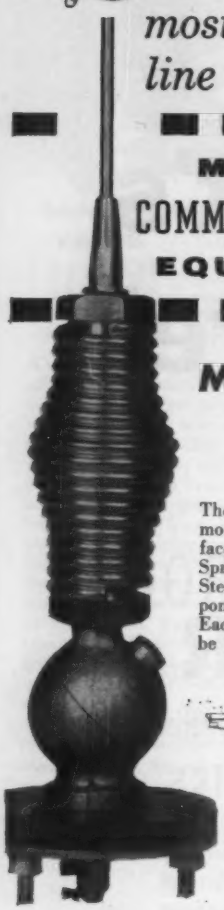


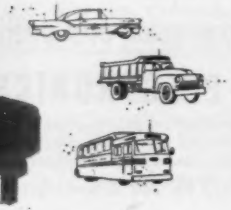
MODEL M-1

List

$14.95

Complete

The M-1 Antenna can be mounted on any body surface. An M-3 Base, M-3A Spring and 96" stainless Steel M-3B Whip are components of this model. Each of these parts may be purchased separately.



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Here is the group of more than fifty hams who traveled from all over the Pacific area in order to attend a recent three-day convention held on Guam.

Far East Ham Convention on Guam

Radio convention, sponsored by Chief of Naval Operations and Marianas Amateur Radio Club, attracts Pacific hams.

THE profusion of palm trees, 80-degree temperatures, and tropical island living, provided the background for the Second Far East American Radio Relay League Convention recently held on Guam. The convention, sponsored by the Chief of Naval Operations and hosted by the Marianas Amateur Radio Club attracted hams from all over the Pacific.

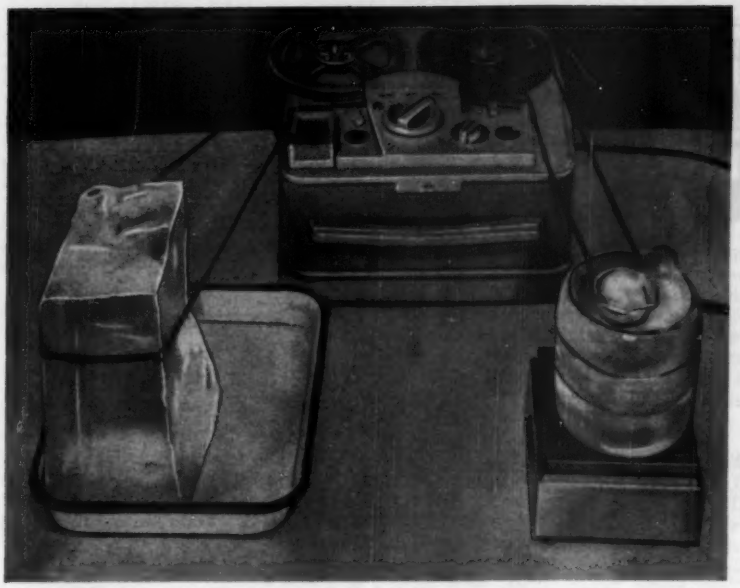
Mr. William W. Willis, President of the Marianas Amateur Radio Club, kicked off the convention with a welcoming speech followed by introductions of various members. Addresses were then given by several top military and civilian officials on Guam, including Governor Richard B. Lowe, Mr. D. H. Nucker, High Commissioner of the Trust Territory, Rear Admiral W. B. Ammon, Commander Naval Forces Marianas, and Major General C. W. Schott, who is the Commanding General of the Third Air Division (SAC).

The Navy offered its facilities to the conventioneers, who were mostly Naval and Air Force personnel, giving them the use of the U. S. Naval Hospital Auditorium, a tour of the U. S. Naval Communications Station, and the facilities at Gab-Gab Beach, a popular recreation area at the U. S. Naval Station.

The convention closed with a critique, a lavish banquet at the Navy Officer's Club, and the singing of "Auld Lang Syne." The general opinion was that a wonderful time was had by all and that next year's convention would be looked forward to with great anticipation and enthusiasm. —30—

Mr. Paul Fonner, FCC inspector from Hawaii, is shown registering for the Second Far East Radio Convention that was recently held on Guam.

Capt. W. A. Smith, USN, who holds amateur call letters KG6AGO and who attended the recent ham convention on Guam, is shown here making a DX contact.



Tape made with "Mylar" is run from the recorder into boiling water and around a cake of ice. There is no change in strength, flexibility, or dimensional stability.

What Do You Know About Recording Tape?

By **HERBERT G. HARD**
Vice President, Research
ORRadio Industries, Inc.

Here are expert answers to most commonly asked questions pertaining to magnetic recording tape.

MORE and more people are becoming interested in tape recording and the uses of tape in the home, in the school, in the church, and in industry. Growing interest in the magic of magnetic recording prompts a good many questions from the ever increasing number of tape recorder fans.

Every year *ORRadio Industries* receives hundreds of letters asking many interesting and important questions about recording tape. In this article we have tried to answer just a few of the most commonly asked questions.

1. How should tape be stored?

Tape should always be stored on the rewind or take-up reel. In the course of recording, or playback, the tape winds on the take-up reel forming a smooth and uniform pack. If it is rewound at fast speed onto the feed reel, it will almost invariably have an uneven pack. Tape should never be stored where it is likely to encounter extreme temperatures or humidity, like in hot attics or damp basements. Storage at ordinary room temperatures is usually satisfactory. Tape should be kept away from magnetic fields such as might be produced around large motors. Stored tape should be re-spooled in playback mode at least once every six months and preferably every 30 days. Frequent respooling also prevents "reel set." This is a more or less permanent deformation of the tape resulting from winding pressure over prolonged storage periods.

2. What is "print-through" and how can it be avoided?

"Print-through" is the transfer of the magnetic signal to adjacent layers on a reel of tape. In order to avoid "print-through" the following precautions should be observed. Do not overrecord. When recording, set the record level as low as possible in order to get a noise-free signal. Rewind recorded tapes frequently. Store at room temperature since higher than normal temperatures accelerate "print-through."

3. What is meant by "single track" and "dual track"?

Single track recording is made with a full track recording head which is almost as wide as the ¼-inch tape. Dual track recording is made with a half track head. It records only half the width of the tape. With a dual track head, the user can record first the bottom half and then the top half of the tape, thus gaining twice as much playing time on one reel of tape. Dual track tapes cannot be readily edited.

4. What types of film, or base, are used for recording tape? and what are the differences between the bases?

The two commonly used tape bases are cellulose acetate and "Mylar," which is *DuPont* polyester film. Each of the base materials has its advantages. Acetate has been the standard film of the recording industry for ten years. It is less expensive than "Mylar." When acetate breaks, it breaks clean and a neat splice can be made without losing any of the recording. "Mylar" is stronger than acetate and will not tear easily. It will take a greater pull before stretching. It also has a high resistance to extreme temperature and humidity.

5. How long will tape last?

The life of good quality recording tape is indefinite. Tests have shown such tapes can be recorded and played up to 10,000 times without appreciable loss of recorded material. A tape with a smooth surface will last longer because it has less oxide shedding due to head contact. "Mylar" tapes will last longer than acetate because "Mylar" does not become brittle with age.

6. Are any precautions necessary for the thinner tapes?

Ordinary care will suffice in the case of 1-mil tapes but certain precautions should be observed in using the half-mil double-play tape. A tape recorder, properly adjusted, exerts a pull of 6-9 oz. while running and 10-16 oz. in start or stop on rewind and fast forward modes. Half-mil tape has a stretch value of 32 oz. which ordinarily provides an ample safety margin. However, special care should be taken on fast forward and rewind. The tape must be taut between reels when starting and stopping. If the tape is slack, it will be snapped into motion and stretching is almost sure to result.

7. How is a tape splice made?

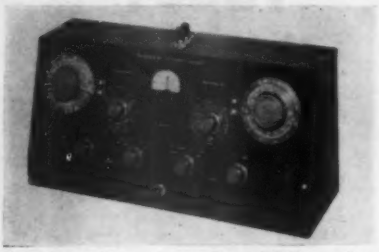
Take the two broken ends of tape, overlap them, and cut through the overlapped ends at a 45-degree angle. Place the two ends together, and lay over a piece of splicing tape. Be sure the splicing tape is not on the coated, or oxide, side of the tape. Trim the edges of the splicing tape with a slight inside curve. Pressure sensitive tape is not satisfactory for splicing, as it makes a "gummy" splice. The job is facilitated by using a splicer. —30—

What's New in Radio

IMPEDANCE BRIDGE KIT

Heath Company of Benton Harbor, Mich. is now offering an improved model of its impedance bridge instrument which is being marketed as the Model 1B-2A.

The new model features more constant filament voltage and more consistent performance. In addition, the instruction manual has an entirely new schematic that clarifies circuit functions in various switch positions. The 1B-2A is a completely self-contained unit with built-in power supply, a 1000 cps generator, and detector.



A 100-0-100 μa. meter provides for null indications. It will measure resistance from 0-1 ohm to 10 megohms, capacitance from 10 μμfd. to 100 μfd., inductance from 10 mhy. to 100 henrys, dissipation factor from 0-200 to 1, and storage factor (*Q*) from .1 to 1000. The decade resistors are 1% units for maximum accuracy.

"FIELD ACCELERATED" TRANSISTORS

Philco Corporation's Spring City, Pa. plant is now in production on a new class of "field accelerated" transistors which have been made possible by the MADT (micro alloy diffused-base transistor) process.

The new family of transistors makes possible the transistorization of high-gain, high-frequency amplifiers; high-speed computers; high-gain wideband video amplifiers; and other critical high-frequency circuitry.

They are available in various voltage and frequency specifications for the design of high-performance transistorized equipment through the entire v.h.f. and part of the u.h.f. spectrum.

PRINTED CIRCUIT RESIST

LePage's, Inc. of Gloucester, Mass., a subsidiary of *Permacel Tape Corporation,* is now in production on a new printed circuit resist which has been developed especially for the purpose of streamlining the production of printed circuit boards.

The new coating is a photosensitive material which covers the copper surface of a circuit board before the image is transferred from a negative to the copper. The resist is a pre-sensitized solution and is ready for immediate use without mixing or other preparation. The new coating keeps well in solution form and will remain stable for six months, according to the company.

A pamphlet on this new product is available on request.

NEW "LIMPANDER" MODEL

Electronic Systems Engineering Co., 903 Cravens Bldg., Oklahoma City, Okla. has recently released a new model of its limiter-expander unit which has been designated as the Model LE-3.

This audio preamplifier with new high-speed, non-feedback automatic gain control incorporates a unique background noise squelching system. It features low impedance and 600-ohm input as well as 600-ohm output which facilitates the incorporation of the unit in existing installations. The limiter portion of the amplifier has time constants of 50 microseconds on attack and 20 milliseconds on release. Consonant amplification is accomplished without the excessive distortion of clipper circuits.

The high-speed background noise squelching system makes it possible to use high-gain, consonant-amplifying, limiting in noise filled rooms.

Write the company direct for full specifications on this new device.

NEW "260" V.O.M.

Simpson Electric Company, 5200 W. Kinzie St., Chicago 44, Ill. has introduced a new model of its popular and well-known "260" volt-ohm-milliammeter.

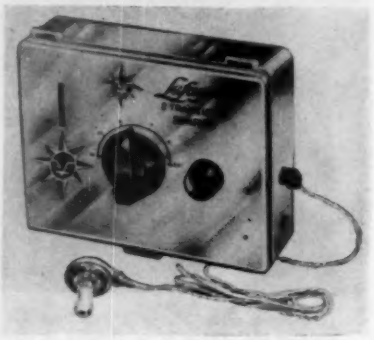
Designated as Series III, the improved model has many design changes which afford quicker operation, increased sensitivity, higher accuracy, and greater dependability, according to the company. Among its new features are a polarity reversing switch, spread-out scales for faster reading, and a rugged printed circuit.

Complete information on the new Series III model is available from electronic distributors or the company itself. In Canada, *Bach-Simpson Ltd.* of London, Ontario will answer inquiries.

"SUNFLEX" TRANSISTOR RADIO

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering an economical two-transistor radio receiver kit for earphone operation, powered by either solar or penlite batteries.

Utilizing two transistors and a crystal diode in an ingenious reflexed complementary symmetry circuit, the "Sunflex" is said to give three-transistor performance. An external antenna plug-in lead is supplied for reception of distant stations. Local reception is obtained without external antenna or ground connections.



The kit comes complete with all parts, transistors, diodes, chassis, plastic case, etc. but less earphones and solar battery. The assembled unit measures 4¾"x3⅝"x1⅝". The solar battery is available at extra charge and is rated at 3.2 volts, 2 ma.

HIGH-HEAT SOLDER PENCIL

Oryx Company, 9015 Wilshire Blvd., Beverly Hills, Calif., has designed a new pencil-type instrument for precision, high-temperature soldering applications.

The new unit, Model 25, weighs less than an ounce, reducing hand fatigue and providing faster soldering, yet achieves tip temperatures of 1000 degrees F while the handle remains cool. It features a 25-watt built-in element supplied with replaceable 3/16" nickel end tip. Also available are ¼" copper-chrome alloy tips.

The pencil operates on 12 volts, 2 amps, either a.c. or d.c. It can be operated from a battery supply or 110-volt a.c. lines by using a stepdown transformer.

NEW BUD RADIO PRODUCTS

Bud Radio, Inc., 2118 E. 55th St., Cleveland, Ohio has added two new units to its line of radio and electronic enclosures.

The first item is a universal meter case which can accommodate either a 2- or 3-inch meter by means of a knock-out ring. Also featured is a one-piece detachable bottom and back which makes installation and servicing much simpler. Two knock-out holes are pro-

vided in the top for installation of feed-through insulators if required.

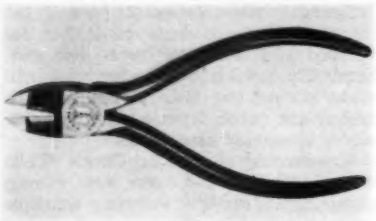
The second product is a universal sloping panel cabinet which also features a one-piece detachable bottom and back. Components may be mounted on back, bottom, sides, or front and still be accessible for service or replacement. Two different viewing angles are possible depending upon whether the cabinet is placed on its bottom or back. Four sizes are being made available.

Both units are being offered in either steel or aluminum. Write the company for literature and prices.

NEW OBLIQUE PLIER

Mathias Klein & Sons, 7200 McCormick Road, Chicago 45, Ill. has announced the availability of a new shear-cutting oblique plier, No. 207-5C.

The new instrument, on which a patent is pending, is 5½" long and the shear-cutting blade will cut dead soft or extremely hard wire. Blades may be replaced, hence the plier never needs sharpening. Regular cutting knives in



the nose add to the usefulness and a coil spring keeps the jaws apart for instant use.

HIGH-FREQUENCY TRANSISTORS

The Semiconductor Division of *Radio Corporation of America,* Somerville, N. J. has introduced a new germanium *p-n-p* alloy-type transistor (2N274) embodying the "drift" principle and a junction transistor of the germanium *p-n-p* alloy type, the 2N404.

The compact design of the 2N274 opens new applications in military and commercial equipment where space is limited. It operates at frequencies extending from the standard AM band well up into the short-wave bands.

The 2N404 is designed for use in switching circuits of compact, medium-speed military and industrial electronic computers. It has flexible leads and is hermetically sealed in a metal case which is .360" in diameter with a body length of .25". Leads are spaced to conform to EIA (formerly RETMA) standards for automation requirements.

NEW RCA COLOR TUBE

The Tube Division of *Radio Corporation of America,* Harrison, N. J. is now in production on a new directly viewed, round, graded-hole shadow-mask tube for use in color television receivers.

The 21CYP22 is designed with an all-glass envelope which reduces the high-voltage insulation requirements of the color receiver. It is also provided with an external conductive bulb coating which, with a portion of the internal conductive coating, forms a supplementary filter capacitor. The graded-hole shadow mask featured in the design has holes that increase gradually in diameter from the outer edge of the mask inward to the center. As a result, the mask permits increased light output from the screen.

The new tube is capable of producing full-color and black-and-white pictures measuring 19¼"x15½" with rounded sides and having a projected area of 261 square inches. The over-all diameter is 20$^{13}/_{16}$" and over-all length 25$^{1}/_{32}$".

A technical bulletin on the 21CYP22 is available on request.

NEW COLOR CAMERA

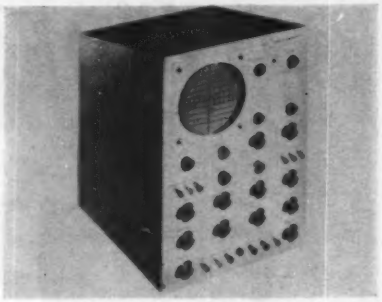
General Electric Company's Technical Products Dept., Schenectady, N. Y. has introduced a new "live" color television camera which is smaller in size, simpler in design, and easier to operate than any now available, according to the company.

It is said to be the first such device to incorporate printed circuits and transistors. These design features permit the camera to measure a mere 34" x 18" x 22" and weigh 215 pounds. A newly developed optical system which is said to eliminate the need for many glass surfaces through which color signals were previously required to pass, results in improved color quality. A single control cable is used to connect the camera to the station control console.

WIDE-BAND OSCILLOSCOPE

Electronic Industries, State Road, Patterson, N. Y., one of the newest firms in the rapidly expanding kit field, has recently introduced a wide-band, high-sensitivity 5-inch oscilloscope kit which has been especially designed for laboratory and television servicing applications.

The Model 535 has a 10 mv r.m.s./



cm. sensitivity from d.c. to 5 mc., an electronically regulated power supply, and push-pull circuitry throughout. Built-in continuously variable calibrating voltages of 100, 10, 1, and .1 volt peak-to-peak at an accuracy of 3% are provided.

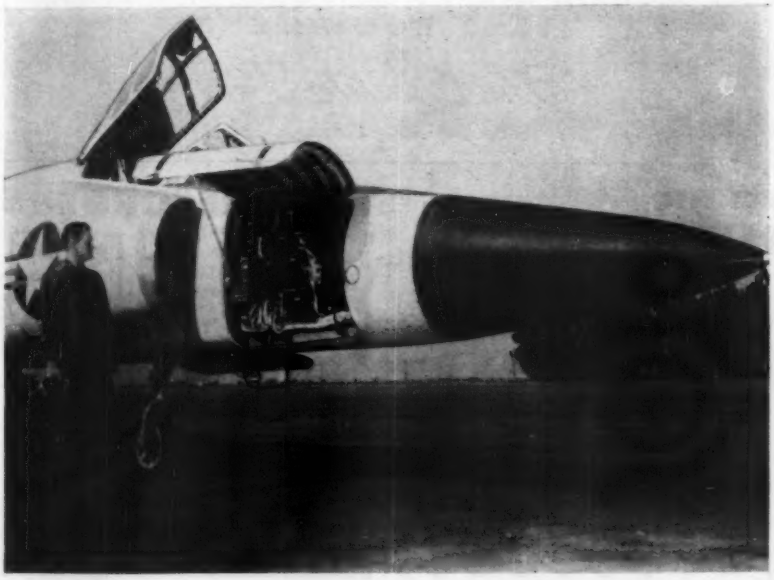
The scope is housed in a blue hammertone finished cabinet with a photo-etched anodized panel. The unit measures 12"x16"x18½" and weighs slightly less than 40 pounds. It will operate on 105 to 125 volts, 50/60 cycle a.c. It draws 150 watts.

TRANSISTORIZED STANDARD

Transitron, Inc., 186 Granite St., Manchester, N. H. has developed a new frequency standard which is designed to be used either as a laboratory or production test tool.

The Model FS-195 is completely transistorized and self-powered, it provides crystal-controlled standard frequency outputs for rapid calibration of oscilloscope sweeps and signal genera-

Shown here is prototype test model of the first airborne digital computer in actual production. The unit, called the Digitair, was announced recently by Hughes Aircraft Co. It is shown installed in an F-102A Air Force all-weather interceptor. The computer is small enough to fit into a 21-inch table model television cabinet.



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tors, or may be used for marker injection in sweep generator displays.

Careful control of its harmonic content provides a continuous spectrum well beyond 200 mc. at usable levels. As a result, this unit may be used to

calibrate communications receivers in both the high-frequency and very-high-frequency bands. The successive use of the 1 mc., 100 kc., and 10 kc. markers allows identification of calibration points as closely grouped as 10 kc. A 400-cycle modulating tone is provided to enable rapid recognition of the crystal-controlled spot frequencies in the absence of b.f.o. provisions in the receiver being calibrated.

"FAST-CHECK TUBE TESTER"

Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y. has developed and is marketing a new economically priced tube tester that will make a complete tube test in seconds and check tubes from a complete TV set in a matter of minutes.

Known as the "Fast-Check Tube Tester, Model FC-1," the new circuit eliminates time-consuming multiple switching and checking of roll charts. Just two settings on the panel enables the technician to check for quality, shorts, and life expectancy of over 600 tube types which covers more than 99 per-cent of all TV tubes including the newest series-string TV tubes, auto battery type 12-volt tubes, voltage regulators, magic eye, and gas regulator tubes.

The tester has 41 tube sockets to accommodate all present and future tube types. —30—

Shown here is a view inside Olson Radio Warehouse's new Akron, Ohio plant. The three-story, 300,000 square foot building is equipped with the latest stock control and handling devices. Olson, which has been in business for 27 years, is the country's second largest electronic component parts distributors, with seven large warehouse-retail outlets.

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2-Way Mobile Service

(*Continued from page* 63)

with your customer relations problems.

The manufacturer will also help you in many ways to get started in this business, and this assistance can be most important. One of the first things to do after you are ready to handle the work is to contact makers of this type of equipment. Tell them about yourself and your desire to service their units in your area. Most of them will be glad to hear from you. Even if, at the moment, they have no need for your services, they will not forget you and will call on you when they need you.

However, before you strike out for yourself, remember that this is a business and requires more than just technical ability. In order to show a profit at the end of the year you must also know how to operate a business. It might, therefore, be best to look into the many opportunities for full-time salaried employment in this field.

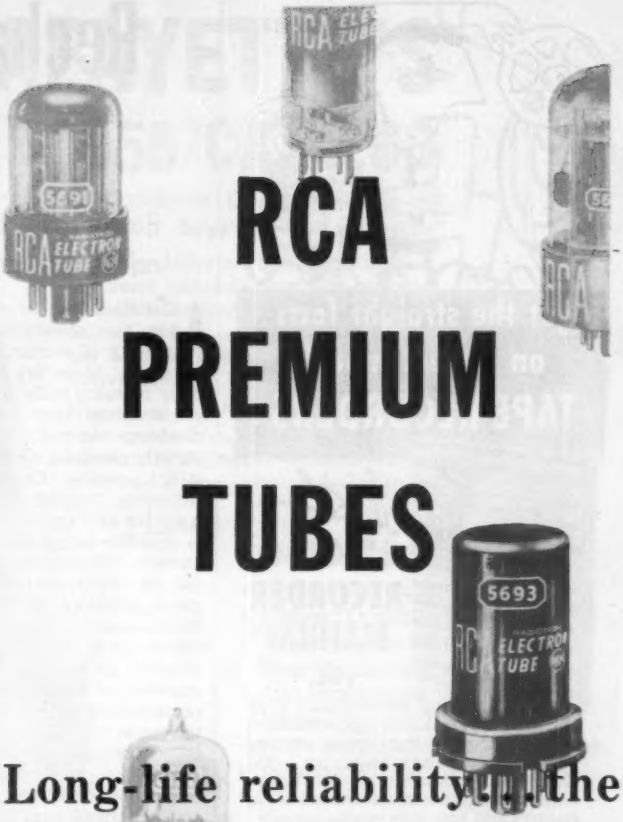
Some operators have their own service departments and need skilled technicians. Also, the independent shops already in this business constantly need technicians. In fact, if you are technically qualified to do this work, it is entirely possible to work in one of these shops while you are studying for your license examination. The FCC rules actually require that a licensed man be *responsible*, so you can earn a salary while studying for your license by doing the work under the supervision of a licensed man.

If you are a shop owner presently doing radio and television service, all you need do is acquire the necessary extra equipment, hire a licensed technician, and you are in business. In this case, it might pay you to get a van-type truck and build yourself a mobile service shop. This is better than trying to make room in an already overcrowded shop.

Also, if you have the qualifications and can operate a business of your own, but don't have the necessary money to purchase the required equipment, you can still get in through the back door, so to speak. If you are lucky enough to be located in an area where a shop is really needed, you should be able to pick up some contracts. With these contracts to prove you mean business and have the ability to pay, it is possible to borrow the money from a bank. Some operators will advance money, to be applied on the monthly contract payments, in order to help you get needed equipment.

If you live near the water or near an airport, check into the possibility of picking up a few jobs there. Invest this extra money in needed test equipment.

Mobile radio communications maintenance is big business. It is getting bigger every day. It will pay you, if you are qualified, to look into it very seriously. —30—



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Electron Tube Division — *Harrison, N. J.*

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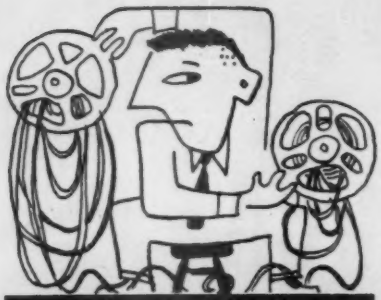

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Recharging and Storing Dry Batteries

Precautions that should be observed in attempting to rejuvenate dry batteries and some storage suggestions.

A GOOD many of our readers have sent us questions concerning the possibility of recharging dry cells and batteries. Since dry batteries are basically *primary cells* in which the chemical reaction that takes place during discharge is not readily reversible, strictly speaking a complete recharging is not possible. On the other hand, by following techniques similar to those used for storage battery recharging, it is possible to extend the life of a dry battery. We usually refer to this process as "rejuvenation," and it is not clear whether there is actually any large amount of replating of active material or if there is merely a small amount of local surface action. Irrespective of the mechanics, enough experimenters have tried recharging dry batteries with enough success to make it worthwhile under certain limited conditions. In most cases of home use of batteries, recharging would not be too practical because the results are just not worth the time, effort, and equipment required. But for the experimenter who may be interested here are some of the facts.

In general, there are two methods that can be used for recharging. One involves the use of more or less steady d.c. while the other uses a combination of a.c. and d.c.

Limitations and Precautions

The battery active materials should not be completely exhausted before recharging is tried. Hence, the voltage under load should not be allowed to fall below 1 volt per cell. In a 9-volt battery then, the load voltage should be above 6 volts. Also, the battery should not be allowed to stand in a discharged condition for very long as it becomes increasingly difficult to recharge such a battery. After the charging has been completed, the battery should be put back into service immediately. This must be done as the shelf life of a recharged dry battery is short.

As to the amount of charging current to be used, this varies depending on the size of the cell to be recharged as well as its normal discharge current. In the main, however, rather low current rates are used. For a penlite cell, or a battery made up of penlite cells, the charging current should be in the range of 4 to 40 ma. For a standard flashlight cell, or a battery made up of standard flashlight cells, the charging current should be in the range of 25 to 250 ma. The charging current should be applied for a period of about 12 to 16 hours in order to be most effective.

The simplest way to obtain the required charging current from the a.c. line is to use a half-wave dry-disc rectifier that is connected to a step-down power transformer. The rectifier used need not have a high current rating since low charging rates are used. The secondary voltage of the transformer should be about 25 per-cent higher than the total voltage of the battery to be charged. Be sure to connect the positive output of the rectifier circuit to the positive terminal of the battery. A series rheostat should be used to regulate the charging current and to keep it within the limits mentioned.

Some experimenters have found that a combination of a.c. and d.c. is more effective in recharging. For some experiences along these lines, we refer our readers to the article "Dry-Cell Battery Charger" on page 128 of our October, 1957 issue.

Storage

Although battery manufacturers have done much to improve the shelf life characteristics of dry batteries, the fact remains that the capacity of these batteries is reduced during prolonged storage. What is more, the smaller dry cells deteriorate more quickly than the larger sizes.

To reduce excessive loss of capacity, dry batteries should be stored at low temperatures. Under these conditions the local chemical action and evaporation that would occur are both retarded. If dry batteries are kept refrigerated, for example, their shelf life would be tripled, according to one manufacturer.

There is not too much danger of freezing dry batteries, as the ordinary dry cell freezes at about −6 degrees F. There have been cases where batteries have been kept near this temperature for many years, and after having been brought up to normal room temperature slowly, it was found that they suffered very little loss of capacity. Batteries that are kept at low temperatures for long periods of time must be thawed out slowly to prevent condensation of moisture that would cause leakage in the jackets.

It has also been found that batteries will last longer if they are given "rest periods" instead of being used steadily. For example, if batteries are to be used for extended periods of time, it would make sense to obtain a duplicate set which could be alternated with the originals. -30-

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D.C. Volts: 0-10; 0-50; 0-500; 0-1000 Volts—A.C. Volts: 0-10; 0-50; 0-500; 0-1000 volts—D.C. Current: 500 ua and 500 ma—Resistance: 0-10K; 0-1 Meg—Decibels: —20 to +22; +20 to 36 db (0 db—0.775 V)—Capacity: 250 mmfd. to .2 mfd—.005 mfd to 1 mfd—Output Ranges: 0-10; 0-50; 0-500; 0-1000 volts.

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼" x 3⅛" x 1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... **Complete 8.95**

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4-SPEED AUTOMATIC RECORD CHANGER

39.50 Reg. 59.95

with NEW G.E. TURNOVER CARTRIDGE VRII and GENUINE G.E. DIAMOND SAPPHIRE STYLI

GE VRII DIAMOND and SAPPHIRE STYLI

NOT A CLOSEOUT—NOT A DISCONTINUED Model, this is a nationally advertised, latest model record changer, with new GE VRII Series Triple Play Cartridge with G. E. Genuine diamond and sapphire styli and is priced so low that we DARE NOT mention the manufacturer's name. This fully automatic record changer has exclusive and deluxe features for the finest hi-fi systems, such as automatic intermix, muting switch, click filter and automatic shut-off after last record. Heavy duty 4-pole shaded pole motor with heavy rim-weighted turntable. 4 speeds, 78, 45, 33⅓, 16-2/3 RPM. Negligible wow and flutter. We are so confident that you will be happy with this purchase, that if for any reason you do not feel you have received an exceptional value, we shall cheerfully refund your purchase price. Size 12¼" x 13⅜", requiring 11/16" clearance above and 2-11/16" below motorboard. Shpg wt., 21 lbs.

PK-250 RECORD CHANGER (less woodbase) with NEW GE 4G-052 Diamond Sapphire Cartridge ..... **Net 39.50**

MAHOGANY OR BLONDE WOODBASE CUT TO FIT ABOVE

PK-111—Specify Finish, Shpg. wt., 5 lbs. ..... **Net 3.95**

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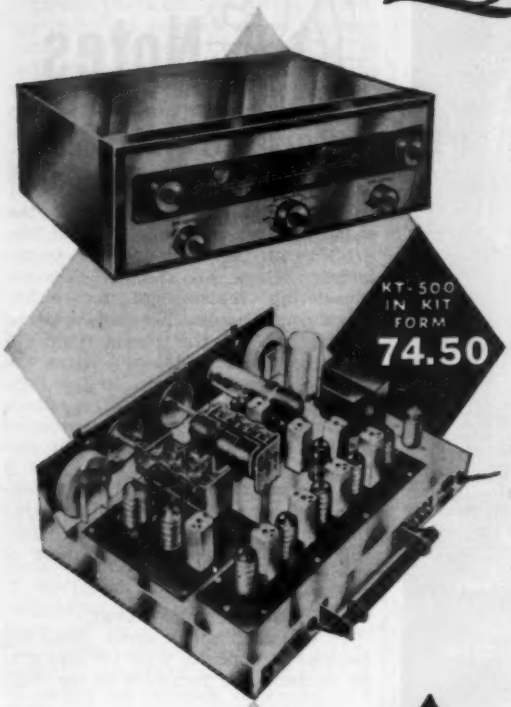
New! YEARS AHEAD! *Lafayette* STEREO TUNER KIT



THE MOST FLEXIBLE TUNER EVER DESIGNED

Use it as a Binaural-Stereophonic FM-AM tuner
Use it as a Dual-Monaural FM-AM tuner
Use it as a straight Monaural FM or AM tuner

- **Separately Tuned FM and AM Sections**
- **Dual Cathode Follower Output**
- **Armstrong Circuit with FM/AFC and AFC Defeat**
- **12 Tuned Circuits**

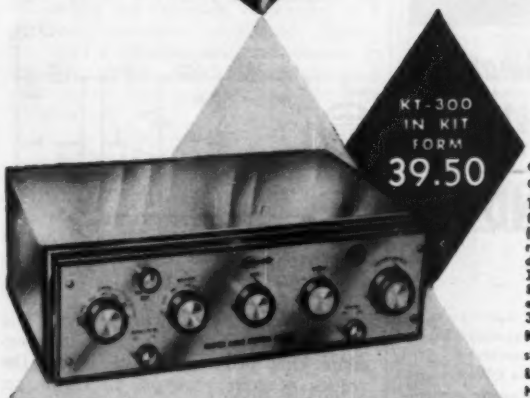
More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8 kc bandwidth and frequency response 20-5000 cps ± 3 db.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500 ..... Net **74.50**



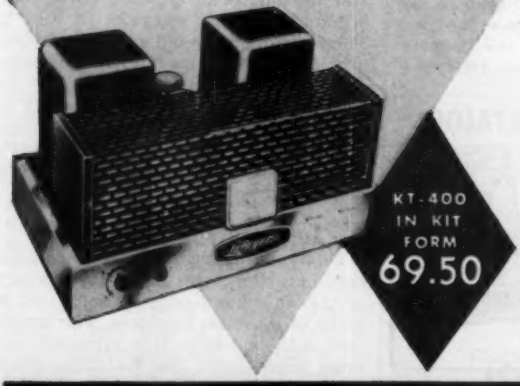
LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROLS

- **Self-Powered**
- **DC On All Filaments**
- **24 Positions of Equalization**
- **Tape Head Input, High Impedance**
- **Dual Cathode Follower Output Stages**

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾ x 9⅛ x 3¾". Shpg. wt., 10½ lbs.

KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. ..... Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. Net **59.50**



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- **Variable Damping**
- **Metered Balance And Bias Adjust Controls**
- **Available in Kit and Wired Form**

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KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. ..... Net **69.50**

LA-70—Same as above completely wired and tested with cage and instruction manual. Net **94.50**

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R/TV-2

ANDREA: INTERMITTENT SOUND

Intermittent sound or fluctuating level of sound in VO-21 and VP-21 chassis may originate in either the sound take-off transformer (Part No. SA-373) or the ratio-detector transformer (Part No. SA-374). Before considering replacement for either transformer, apply a hot soldering iron to the lugs of the transformers to make certain that the coil wires are making good connection to the lugs.

If the condition is of such a nature that the sound fluctuates or becomes intermittent only after the set has been in use for a long while and if the audio tubes have already been tested or replaced without eliminating the symptom, it may be more economical to replace both transformers at the same time.

G-E: VERTICAL SYNC

In certain problem areas, there has been some difficulty with vertical sync on portable TV receivers in the "Q2" series, using 14" picture tubes. The manufacturer has been able to overcome this problem by changing the values of four resistors in the a.g.c. and video-detector circuits. These four are marked with asterisks in Fig. 1. The resistors, with old and new values, are: R_{138}, from 22 megohms to 20 megohms, 5%, ½ watt, carbon; R_{139}, from 220,000 ohms to 180,000 ohms, 10%, ½ watt, carbon; R_{139}, from 2.2 megohms to 1.5 megohms, 10%, ½ watt, carbon; and R_{161}, from 22,000 ohms to 33,000 ohms, 10%, ½ watt, carbon.

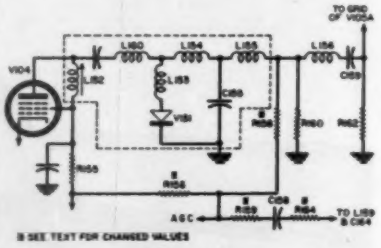

Fig. 1.

AUDIO-OUTPUT TUBE FAILURE

Firestone notes that there has been some problem with premature failure of the 25C5 audio-output tubes used in some of its radio receivers. The broadcast sets in which this symptom has been noted carry the following stock numbers: 4-A-169, 4-A-170, 4-A-171, 4-A-172. The short life of the tubes has been found to result from excessive grid emission which is present in the tubes as they are received from their

manufacturers. Some runs of some tube brands will show excessive grid emission, whereas others will be free of it. The wisest procedure is to keep a careful check on new 25C5's as they are delivered to catch tubes that are faulty in this respect early and to use only those known to be free of the symptom in the receivers just noted or others that may be critical in the same way. Tube runs that are known to be faulty in this regard should be avoided.

OLYMPIC: FUZZY PICTURES

Under certain conditions of transmission, chassis in the DD or DDU series will exhibit pictures that appear

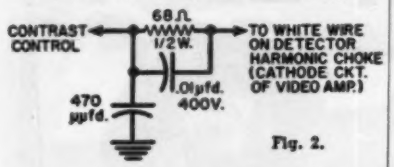

Fig. 2.

to be fuzzy or smeared. To compensate for this condition, a simple network consisting of two capacitors and a single resistor is added to the cathode circuit of the video amplifier, a 6AW8. If this circuit has not already been incorporated in the receivers in question, there will be a white lead going from the contrast control to a choke which, in turn, connects to pin 6 of the 6AW8. To install the network, consisting of a 470-$\mu\mu$fd. capacitor, a .01-μfd. capacitor, and a 68-ohm resistor (shown in Fig. 2), simply break the white lead and insert the network as per the illustration.

MAGNAVOX TUNER DETENTS

Tuner detent spring life in 700584 and 700587 tuners, used in current models, can be extended by applying

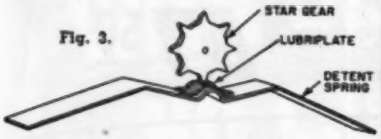

Fig. 3.

Lubriplate 105 at the point of contact between the detent gear and the spring itself. The manufacturer suggests that this measure be taken whenever a chassis using either of these two tuners comes in for shop service, regardless of whether the tuner is involved in the service complaint or not. The lubricant should be applied generously, as indicated in Fig. 3, in the area that has been shaded in gray. In this connection, note that it is very important that both sides of the point of contact on the detent spring be well lubricated, as well as the point of actual contact itself. When treated in this fashion, the springs should last the life of the receiver without the need for replacement. If an untreated spring should wear out, it is easily replaced, however. To order replacement detent springs, refer to *Magnavox* part number 635580. —30—

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• 160 Kc to 240 Mc in 8 bands
• 120 Mc fundamental output
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Same as Model G-30 but with pre-calibrated front end.
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• full free-point lever selector system
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• 10 mmfd to 2000 mfd
• ½ ohm to 200 megohms
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RF-AF SIGNAL TRACER KIT
• High gain RF & AF Amplifier
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Model M-40
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Superior's New Model TD-55
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The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

• **You can't insert a tube in wrong socket.** Separate sockets are used, one for each type of tube base. • **"Free-point" element switching system** Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap". • **Checks for shorts and leakages between all elements.** Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. • **Elemental switches are numbered in strict accordance with R.M.A. specification.** The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: Elimination of old style sockets used for testing obsolete tubes (26, 27 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TD-55 comes complete with operating instructions and charts and streamlined carrying case.

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Superior's New Model TV-40

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Of course you can buy an adapter for about $5 —which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else.

Tests ALL magnetically deflected tubes
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Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.

- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
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Comes absolutely complete — nothing else to buy. Round cornered molded bakelite case. Only ...

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Superior's New Model TW-11

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STANDARD PROFESSIONAL

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- Uses the new self-cleaning Lever Action Switches for individual element testing. **All elements are numbered according to pin-number in the RMA base numbering system.**
- Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is **impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE
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Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

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TRANS-CONDUCTANCE TUBE TESTER

The new Model TV-12

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

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2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ **SIGNAL TRACER SECTION**
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

✓ **TV ANTENNA TESTER SECTION**
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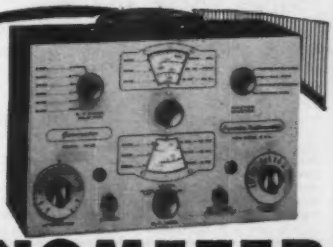

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R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

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The revolutionary KWM-1, the first mobile transceiver to offer SSB. And this 14-30 mc 175 watt package is equally adaptable to fixed use with simple removal from a convenient mounting tray under the dashboard.

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KWM-1 Transceiver	$820.00
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For Smooth Coordination of Complete SSB Station

The SC-101 provides the necessary equipment to connect the Collins 75A4 and KWS1 with beam direction indicator and control, phone patch circuit, standing wave ratio meter and remote selection of any one of six antennas. *There are three units included in the system:*

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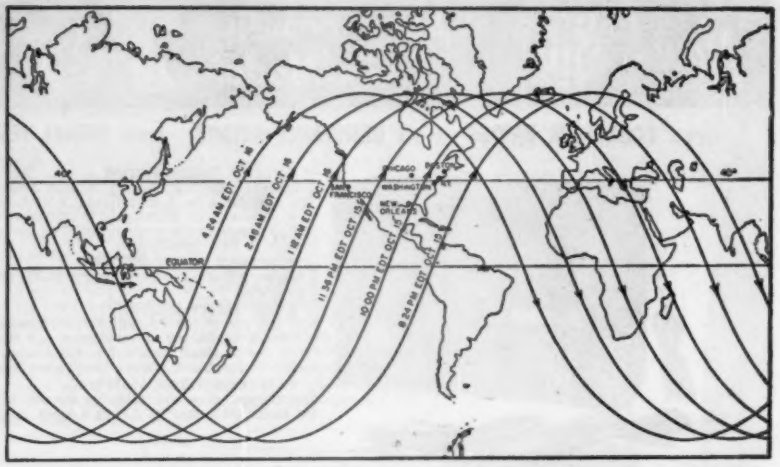

Example of orbit prediction of USSR satellite prepared by U.S. Naval Research Laboratory. Times computed for latitude 40°N; released October 15, 1957, 11:30 a.m.

Report on the Soviet Earth Satellite

Summary of radio observations and instrumentation employed in man's first artificial earth satellite.

THE material below is based on a composite of unofficial reports on the first USSR satellite which was launched on October 4, 1957. The information was taken from the "IGY Bulletin", a survey by the U. S. National Committee for the International Geophysical Year.

Instrumentation

The first announcement by Radio Moscow indicated that there were two transmitters in the satellite, one operating at 20.005 mc. and the other at 40.002 mc. The pulse of each signal was 0.3 sec., followed by a pause of similar length during which the other signal was transmitted. On Oct. 8 the signals were not received for several hours. Later, signals resumed but became continuous. The transmitter power was specified to be 1 watt. U. S. monitors agreed that the signals were modulated with telemetry data. Appropriate instruments within the satellite reported on atmospheric temperature and density. Also, information on micrometeorite bombardment was probably transmitted.

Radio Observations

First U. S. radio reception of the satellite's signals was reported by *RCA Communications, Inc.* at Riverhead, L. I. The observation occurred at 8:07 p.m. EDT, October 4, the day of the launching. At 8:15, the signal was strongest from the south. First reception at the Naval Research Laboratory in Washington, D. C., was at 8:30 p.m. By October 6, six of ten Minitrack stations had been converted from 108 mc. —the frequency to be used by the U. S. satellites—to 20 and 40 mc., in order to track the USSR satellite.

Radio reception was soon general and reports of continuous monitoring were received from Antarctic IGY stations, including the South Pole—which is in a position to hear the satellite on virtually every passage—as well as from IGY Drifting Station A, an ice floe located about 500 miles from the North Pole.

Reports from the Amundsen-Scott South Pole Station indicated that the satellite's radio signals cut in abruptly but faded out gradually and that there were numerous variations in signal strength, duration, and pulse rate.

The USSR was reported to be encouraging amateur assistance, offering special cards to hams reporting receipt of the satellite's radio signals.

Radio Moscow announced on October 26 that the satellite's radio had used up its power and had stopped working. On the same day, the Naval Research Laboratory reported that no signals had been received by Minitrack stations since 5:50 p.m. EDT, October 25, and that no other information had been relayed to NRL from other radio receiver sources since 7:10 p.m. EDT, October 25. Thus, after 3 weeks of continuous operation, space's first radio transmitter had gone dead. —30—

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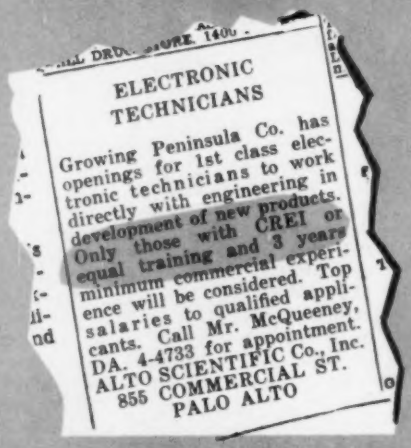

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Tom L. Dimond points to writing area with metal stylus of the unit he has invented.

New Device Reads Written Numerals

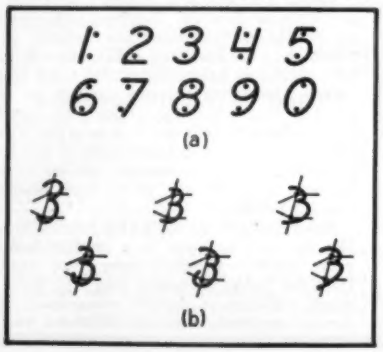
Experimental unit using transistors is run by ordinary flashlight cells.

AN EXPERIMENTAL device the size of a portable typewriter that can read handwritten numerals or identify numerals as they are being written was demonstrated recently. The machine, invented by Tom L. Dimond of *Bell Telephone Laboratories*, could be modified to read handwritten letters. The unit may eventually become a valuable addition to telephone offices in picking up handwritten information on long distance billing tickets.

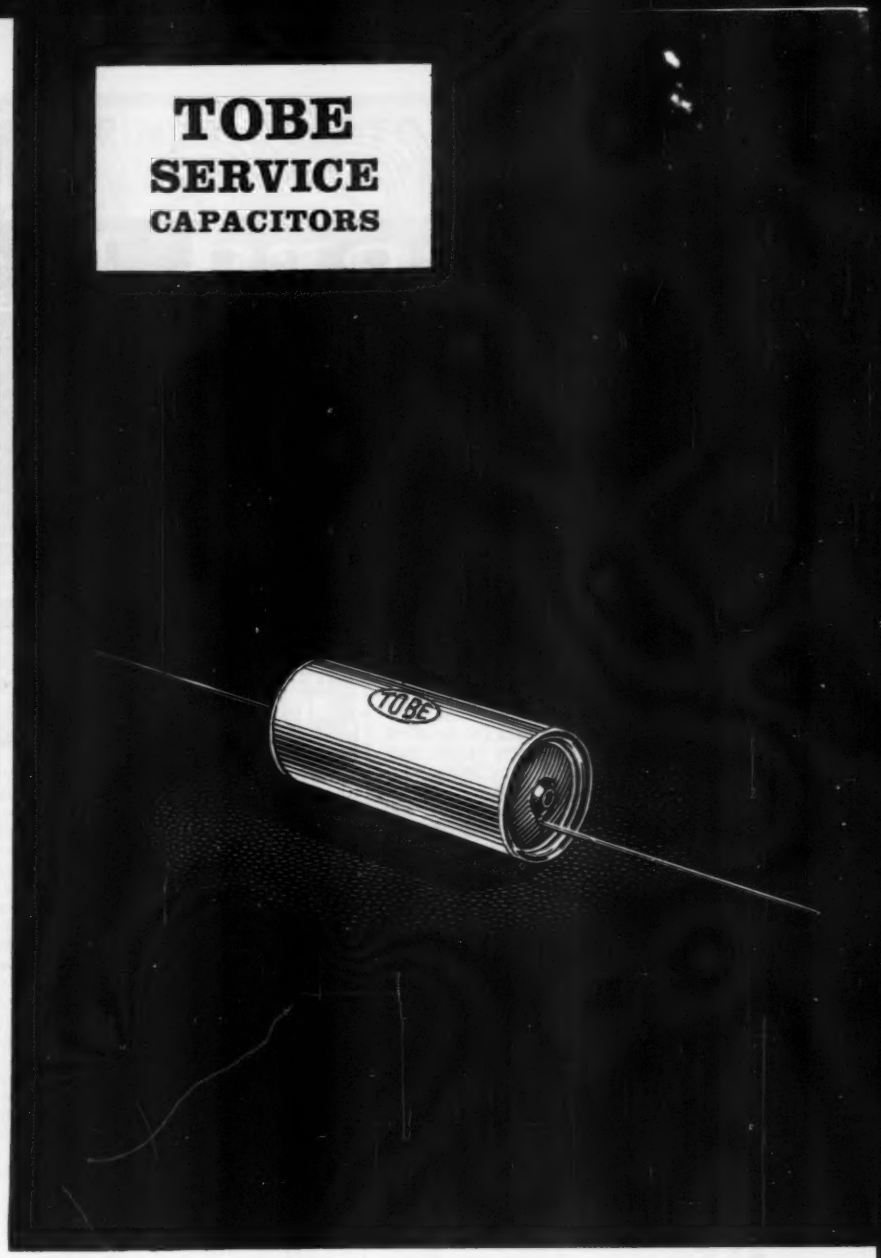
The device indicates the number that is being written by lighting up the correct digit on a numbered panel. This information could also be transferred to an accounting machine, computer, or other data processing device.

Several experimental models have been built. Each is completely self-contained. The unit is operated from ordinary flashlight batteries. Its small size is made possible by the use of transistors. -30-

(A) The two dots on the writing screen must be used as a guide in the formation of numerals. (B) Wide variations are permissible in forming numbers, such as are illustrated here with the number 3.



TOBE SERVICE CAPACITORS



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TOBE RADIART CAPACITORS

Old Hands at Dependability

Certified Record Revue

by Bert Whyte

SEVERAL months ago I sounded a warning about anticipated price increases on recordings. By the time you read this, both *Capitol* and *Victor* classical discs will be selling for $4.98 instead of the old $3.98 price. There may even be others by that time and very soon the price change will be industry-wide. You can't say I didn't give a holler in time! The effects of this return to higher prices can't be accurately assessed at this time. Perhaps it will lead to a slump in classical record sales. If that does happen you can look for an early return to the lower price.

One effect, however, is quite certain and that is that recorded tape will occupy a more advantageous position. With some of the lower-priced tapes, people will begin to compare the shrinking margin between the price of the tape and the disc *versus* the question of longevity and deterioration of the two media. In a case like this, tape would win, hands down. This disc price rise is sure to give impetus to the stereo tape market, but I also feel that one of the possible reasons for the return to the higher price disc is in paving the way for the stereophonic disc. It has been generally conceded that when the stereo discs come, they will be at or near the original LP price. The possibility of $4.98 as the universal disc price for either monaural or stereo should not be too far-fetched.

Speaking of the stereo discs, it can be reported that as of this writing, *Capitol, Columbia, Victor,* and *Decca* have all purchased *Westrex* cutters. This does not necessarily mean these companies are going to adopt the *Westrex* stereo disc system, as reported elsewhere. The *Westrex* cutter is capable of cutting stereo discs by its own "45-45" method, but it is also capable of cutting straight vertical/lateral stereo. The companies are experimenting with both systems and no one has officially adopted one or the other. A persistent rumor has one of the majors introducing the stereo disc in July, but unless the system has been decided upon by then, this won't happen. I'll do my best to keep you posted.

TCHAIKOVSKY
VIOLIN CONCERTO IN D
Jascha Heifetz, violinist, with Chicago Symphony Orchestra conducted by Fritz Reiner. Victor LM2129. Price $4.98.

It is hardly necessary to note that there are umpteen versions of this concerto, among which are some outstanding examples of virtuosity and fine recorded sound. More to the point is to urge you not to overlook this version, because of an embarrassment of riches. For with all due respect to the illustrious executants on the other discs, none can quite match the magic wrought by Heifetz. This concerto is peculiarly "his," a commanding, authoritative *tour de force* of violin playing. This is audibly evident, as he sweeps into the work with bold assurance and immediately captivates you with the lush beauty of his tone, the facile ease with which he overcomes the technical difficulties of the score.

Brilliantly *en rapport* with Reiner, Heifetz affords us a reading which is unlikely to be surpassed for some time to come. Soundwise, this has the formidable advantage of Orchestra Hall acoustics, which lend a great "presence" to the soloist and orchestra.

The work was recorded fairly "close-up," affording crisp, clean definition to the instruments, yet avoiding any stridency in the strings. Excellent transient response was noted throughout the disc and dynamic range was wide and expressive. There are several other versions which can equal this recording in terms of sound, but with this fabulous Heifetz performance as a plus to the fine sound, this is easily the recording of choice.

DVORAK
SERENADE FOR STRINGS IN E MAJOR
Israel Philharmonic Orchestra conducted by Rafael Kubelik. London LL1720. Price $3.98.

The Israel Philharmonic's tenure with *Angel Records* was surprisingly short and now the orchestra records for the *London* company. What precipitated the Israel Philharmonic's move to *London,* I don't know. Certainly on the basis of the few albums issued by *Angel,* the orchestra displayed considerable resources and much promise. Here under the baton of the versatile Kubelik, they give every evidence of continued improvement. The Dvorak "Serenade" has had three previous recordings on LP, none of which were wholly satisfactory. Kubelik has always had a way with strings and under his urgings the Israel group performs this lovely score with great tonal beauty. The first strings seem to be the best trained, although ensemble work throughout the recording is of very high order. A fine balance between the various choirs is maintained by the engineers and as a whole, the sound is very clean, quite spacious with good dynamic expression.

STRAVINSKY
PETROUCHKA
FIREBIRD SUITE
Paris Conservatoire Orchestra conducted by Pierre Monteux. Victor LM2113. Price $3.98.

I listened to this recording once . . . I listened to it twice . . . and yet a third time. I twiddled dials on my preamp, adjusted this and adjusted that, I did everything but stand on my head to no avail. Here was one of the really great performances of "Petrouchka" and the "Firebird," with a technical fault so obtrusive that it spoiled the magnificence of the reading. Papa Pierre is not at fault . . . this incredible septagenarian who was . . . shall we say midwife at the debut of so many Stravinsky masterpieces . . . affords here readings that must be considered as near definitive. In "Petrouchka" alone he has illuminated passages which previously were somewhat murky in meaning and meter. I have discovered subtleties and nuances in the score heretofore unknown. He has introduced me to an appreciation of just the right emphasis here, just the right diminuendo there, just the very proper handling of this score, bar-by-bar.

The sound in general is lovely, very clean, well balanced, good acoustics and good dynamics. But Gadzooks! Some cluck didn't monitor the tape too carefully and on the disc we have the most repulsive and annoying 50-cycle tape hum! This hum was practically a concomittant of many European tapes in the early days of LP, but I thought this was a problem long since licked. Evidentally not and for shame *RCA!* I can only hope that this hum was confined to my copy. I can hope still further that when the stereo tapes of this program are released, the hum will be conspicuous by its absence. You might try a few copies and see what gives . . . maybe I got a dud. But even if the hum is there, do yourself a favor and listen to this magnificent recording.

BERLIOZ
ROMAN CARNIVAL OVERTURE
BENVENUTO CELLINI
WAVERLY
LES FRANCS-JUGES
Philharmonic Promenade Orchestra conducted by Sir Adrian Boult. Westminster XWN18523. RIAA curve. Price $3.98.

A jumbo collation of Berlioz overtures, nicely served by Sir Adrian and engineered to a turn by *Westminster.* Sir Adrian's greatest asset here is in his lack of pretension, which allows the works to stand by themselves. He wisely lets the many-faceted Berlioz draw our main attention while he gently guides us through the intricacies of the scores. Very full, open sound, with good clean strings, mellow woodwind, robust brass, and notably accurate percussion. Wide dynamics here and a broad acoustic perspective.

DEUTSCHMEISTER ON PARADE
The Deutschmeister Band conducted by Julius Herrmann. Westminster XWN-6058. RIAA curve. Price $3.98.

Ever since the first big *oompah* issued from the Deutschmeister Band's original *Westminster* recording several years ago, it has been a big favorite with the hi-fi fans. In this, the latest in the series, the Band reaches a new high in fi. In a group of 10 marches some familiar and others total strangers, the Band disports itself with the spirit and precision that have made it world-famous.

DELIBES
COPPELIA (COMPLETE BALLET)
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL1717/18. Price $7.96. Two discs.

This is a notable first edition for Ansermet and *London Records.* Yes, this is the complete ballet of "Coppelia," *not* the suite with which we have had long familiarity. It has been almost an axiom that Suites taken from ballets have always been justified on the grounds that what was excised was nearly always dull and tedious. Not so with "Coppelia." There are pages and pages of wonderful music beyond the familiar sections to enjoy and savor, enough to fill both sides of two LP records.

Ansermet is at the top of his form in music like this and he gives us a reading full of verve and life. He elicits some great playing from the Suisse Romande men and there is much evidence of careful rehearsing. The *London* engineers have contributed a sound of superb delineation . . . every facet of or-

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50 WATT, 6 CHANNEL RADIOTELEPHONE FOR BOATS OR FIXED STATIONS

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50 W. RADIOTELEPHONE (BC-669 A, B, or C). USED-EXCELLENT, as described above. Shpg. wt. 185 lbs. **EACH** **$99.50**

SAME AS ABOVE, NEW-UNUSED. EACH **$139.50**

12 V. DC POWER SUPPLY, for above. Has 2 Dynamotors, one for transmitter (540 V. at 450 ma.) and one for receiver. Produces 50/60 watts output. All wired and tested. **EACH** **$89.50**

COMPLETE 12 V. DC POWER SUPPLY KIT. Assemble and wire yourself. All material and diagram. ..**$45.00**

PE-110 A, B, or C POWER SUPPLY for 110 V. 60 cycles AC operation. LIKE NEW condition. **EACH** **$89.50**

HANDSET FOR ABOVE with appropriate plug connector **$14.50**

15-600 KC RECEIVER

Navy Model RBL, mfd. by National and Wells Gardner —(both types available) for ship and shore application. Designed for 110V. AC. 60 cycle operation. Receives CW and Voice Phone signals, throughout the entire range of 15 to 600 KC in 6 bands. Employs 7 modern metal tubes in TRF circuit with regeneration, plus two audio filters to allow choice of two band widths. 600 or 3000 cycles at 20 db down with peak response occurring at 750 and 1000 cps respectively. Also incorporated audio limiter stage which reduces noise and interference. This is an excellent receiver for wireless operators, hams, and all others interested in the long and intermediate wave bands. Dim: 17⅜" L. x 15½" D. x 10½ H. (less shock mounts). Supplied complete with tubes, instruction sheets and diagram. Shpg. wt. 110 lbs.

PRICE, EACH. GOOD—USED, UNTESTED .. **$34.95**

NEW, WALKY-TALKY (BC-611) CHASSIS

Here's the chance to build your own real compact, lightweight hand-held Walky-Talky! Designed to transmit and receive on one (crystal-controlled) frequency between 3.5 and 6.0 mc. any real Ham could revamp the coils for operation on higher frequency amateur phone bands. This will result in increased antenna power output and longer distance transmission. By building your own case for this chassis, with space for larger batteries and increased B voltage, further increased power and longer service from batteries will result. These chassis are NEW, unused, complete with telescoping antenna but less tubes, coils, or crystals. Tubes required: 1—1R5, 1—1S5, 1—1T4, and 2—3S4, 2 miniature plug-in coils required (sold separately), 1—Antenna, and 1—RF Tank. Battery voltages required (original) 1—1.5 volt "A" and 103 volts "B" battery, the latter may be increased to 135 or 167.5 volts to produce higher transmitter output. Supplied as specified with Schematic diagram. Shpg. wt. 6 lbs.

EACH—Chassis only **$8.95**

PAIR OF COILS, for above. Ant. & RF Tank.... **$1.25**

ACCESSORIES FOR ABOVE

CAST ALUMINUM HOUSING, case for Above Walky-Talky. Includes battery compartment, Push-to-Talk Switch with rubber weatherproof cover, top and bottom covers. All items separate for home assembly. **PRICE,** as outlined **$17.75**

MICROPHONE & RECEIVER ELEMENTS, with matching transformer and bakelite covering caps.

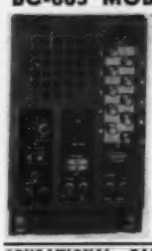
EACH (New) **$5.50**

TEST UNIT I-135. Contains Microphone and Receiver elements, Volt-Milliammeter, and RF Pierce Oscillator circuit to thoroughly test above Walky-Talky. Parts can be used to help complete unit. Used-Excellent. Shpg. wt. 35 lbs.

PRICE, EACH **$17.95**

Inquiries invited from Exporters, Governmental Agencies and Industrial Companies. We have a large selection of communications equipment and specialized electronic material.

BC-683 MOBILE FM RECEIVER



Provides 10 push-button selected channels as well as continuous variable tuning over the entire range of 27.0 to 39.0 mc. Includes features such as: built-in loudspeaker, squelch circuit, A.V.C., double limiter circuits, headphone jacks, sensitivity control, accurate calibrated tuning dial, etc. Supplied complete with 12V. DC Dynamotor for 12-volt operations, all tubes, and schematic diagram which is glued to bottom of housing case. Shpg. wt. 65 lbs.

PRICE, EACH, Used-Excellent Condition. **NOT TESTED** **$24.95**

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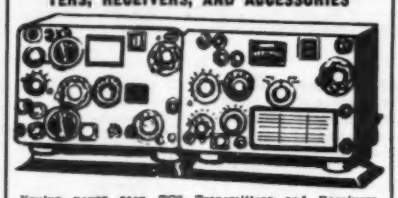

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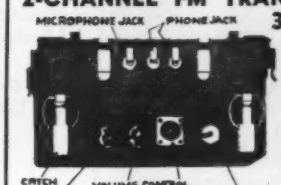
2-CHANNEL FM TRANSCEIVER 30-39 MC.



The BC-1335 is an 18-tube lo-power (1.5 watts) transmitter and receiver for FM. Ideal for mobile installations, operating from either 6 or 12 volts DC (self-contained power supply), especially for receiver monitoring of fire or police calls; transmitter would have to be FCC type approved. Both transmitter and receiver are crystal-controlled. Receiver employes 11 tubes of miniature variety in a highly sensitive superhet circuit with limiter and discriminator stages, to produce maximum reception. FM transmitter employs 7 miniature tubes. Its range is about 5 miles (from vehicle), and may be used in remote areas or for emergency purposes where FCC approval. However, at the price we are asking, and considering the compactness of this transceiver (11⅛" L. x 10¼ D. x 6¼" H.) it's a swell buy just to use the receiver section only. All in Used-Exc. cond., compl. with tubes, and schematic diagram. Not tested, at price quoted.

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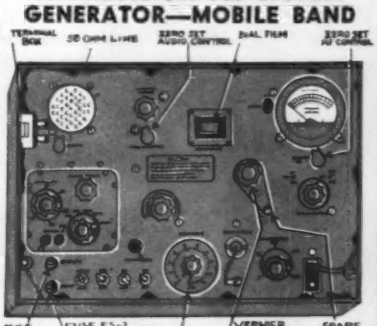

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VIEUXTEMPS
CONCERTO #4 FOR VIOLIN AND ORCHESTRA
Zino Francescatti, violinist with Philadelphia Orchestra conducted by Eugene Ormandy.

LALO
SYMPHONIE ESPAGNOLE
Zino Francescatti, violinist with New York Philharmonic Orchestra conducted by Dimitri Mitropoulos. Columbia ML5184. Price $3.98.

Francescatti is by now a seasoned and superb violin virtuoso, excelling in certain works and more than holding his own in most of the standard repertoire. His reading of the "Symphonie Espagnole" is at the top of the list for its rounded sweetness of tone and his dazzling technique. However there are other good recordings of the Lalo work and the item of real interest here is the lovely and rarely heard Vieuxtemps concerto. This is an ingratiating score, quite melodious and not relying too heavily on violin gymnastics to sustain interest.

After so much of the standard fare this is a refreshing novelty which deserves to be heard more often. With these two great orchestras on one disc a comparison of their sound is interesting. In both cases the recording is close-up and highly detailed, with excellent balance between soloist and orchestra. Acoustically, the Academy of Music in Philadelphia favors string tone more than the Carnegie Hall locale of the Philharmonic which favors brass and percussion. All in all a good coupling and a very worthwhile recording.

STRAUSS
EIN HELDENLEBEN
Saxon State Orchestra of Dresden conducted by Karl Bohm. Decca DL9927. Price $3.98.

This is an odd recording of this great work. It has the huge sonority which the score demands, yet in critical places . . . the Battle Scene . . . for instance the dynamics are strangely subdued. Bohm gives a fine reading of the work, but his is not on the order of a Mengelberg or Reiner. His performance is best described as competent and honest. The sound is very huge with a great hall liveness. The recording was not too close up and detail suffers accordingly. The most outstanding feature of this recording was the orchestral balance and the great sonority of the contrabass. This was in the best European tradition and had there been more projection to the sound, this would have been far more successful.

PROKOFIEV
ROMEO AND JULIET (COMPLETE BALLET)
Ballet Russe Orchestra conducted by Mladen Bashich. Concert Hall 2XK1513. Price $9.96. Two discs.

The *Concert Hall Society* has engaged in a venturesome project of recording complete ballets, many of which are comparatively obscure. These are impressive productions under the sponsorship of the International Ballet Guild. The packaging is quite deluxe, with lavish background data on the ballets and many illustrations depicting the performance history of the particular ballet. In this album we have the first complete recording of Prokofiev's "Romeo and Juliet." On listening, it is obvious there is much more to the score than the snippets we have had in

recordings up to now. This is wholly impressive music, with relatively little dross among the gold. The orchestration is typically Prokofiev, replete with plenteous woodwind and his easily identified rhythmic figures. The only basis for comparison we have is the various "suite" recordings, the most extensive of which is the Stokowski/*Victor* version. It must be admitted that in spite of its completeness, neither the performance nor the sound measure up to the Stokowski disc. Bashich seems competent enough and his orchestra plays quite well, but he fails to capture the magical essence of the score or to emphasize its sensual beauty in the same fashion as Stokowski.

Soundwise this is a good clean recording, with fine string tone, really excellent woodwind sound, good brass. The trouble is that there is not enough weight or body to the sound, the orchestra seeming smallish compared to the Stokowski forces. But after all, the Maestro poured the experience of years into his reading and recording and in music of this character, Stokowski is literally unbeatable. However, for those who are ballet enthusiasts and who want a full length view of this work, this is altogether an admirable production and is recommended without reservation on that basis.

SEGOVIA AND THE GUITAR
Andre Segovia, guitarist. Decca DL9931. Price $3.98.

There are other good classical guitarists on records, but there is only one Segovia. This unassuming artist has been "Mr. Guitar" for many years now and seems to be in no danger of being supplanted. Here in a varied program of works by classical composers such as Scarlatti and Dowland, and countrymen Manen and Espla, Segovia shows why he is supreme in his art. The incredible dexterity of his fingering, the rock-bound rhythm, the colors and shadings of his phrasing, his expressive dynamics all contribute to his fabulous musicianship.

The most interesting work on this disc is by his Spanish contemporary, Manen. In the free form of a fantasia it runs the gamut of emotions through a solemn largo to a gay and lively allegro. Segovia's guitar is flawlessly reproduced, with great tonal beauty and superb transients. The plus attraction of dead-quiet surfaces helps the cause of realism.

MENDELSSOHN
SYMPHONY #3 ("SCOTCH")
FINGAL'S CAVE OVERTURE
London Symphony Orchestra conducted by Antal Dorati. Mercury MG50123. Price $3.98.

The third symphony of Mendelssohn has not received the attention afforded some of his other works, notably the 4th symphony. Thus this new recording is doubly welcome for its content and the excellence of interpretation. Dorati has always had a knack for Mendelssohn and his reading here is exemplary. He essays judicious tempi throughout the score, being just a mite faster than most other recordings of the work. His is a very spirited reading, as full of vigor and life as the robust Scottish highlands which inspired Medelssohn to write the work.

His reading of the "Fingal's Cave Overture" is quite exciting, capturing in music the restless swell and surge of the sea. The sound throughout is superb. The somewhat thick-textured Mendelssohn is perfectly articulate here, with rich smooth strings, bright brass, persuasively live woodwinds and sharp clean percussion. The famous tympani rolls in the "Fingal's" come through well defined and with weighty impact. As in all of the English series of recordings, Dorati gets some beautiful playing from the *London Symphony*. Large acoustic frame here coupled with sparkling orchestral detail. Frequency range was

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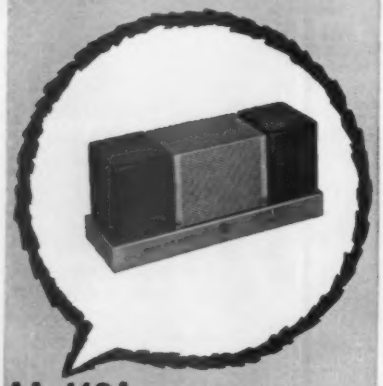

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wide and dynamics equal to the demands of the score. Without question this is the recording of choice among the existing versions of both works.

RACHMANINOFF
PIANO CONCERTO #1
STRAUSS, RICHARD
BURLESKE
Byron Janis, pianist, with Chicago Symphony Orchestra conducted by Fritz Reiner. Victor LM2127. Price $4.98.

This disc is sure to become a best-seller. Combine the elements of interesting repertoire, with virtuosic pianism, the playing of a great orchestra, and brilliant hi-fi sound and the results can hardly be otherwise. The Rachmaninoff is a much needed item. To be sure we have the incomparable Rachmaninoff himself available on records, but great as his performance was, there is no denying that his dated version is sadly lacking in the sound department. Young Janis is no Rachmaninoff . . . but what he lacks in tone and polish he makes up for in exuberent spirit and brio combined with good solid musicianship. Aided by the superbly clean wide range recording, his reading is most impressive sounding.

In the "Burleske," Janis faces some tough opposition, in the modern recordings by Gulda, Serkin, and Weber. It is much to his credit that he does as well as any of them. Soundwise, his is the best recording to date, a fact which is evident from the opening tympani figure. The piano sounds wonderful in the Orchestra Hall acoustics, being very big-toned and especially sonorous in the bass. Transients were sharp and clean, and there was no sign of harshness or ringing. Reiner affords a splendid accompaniment in both works and the orchestra has a real workout with the colorful scores. Highly recommended.

BEETHOVEN
SYMPHONY #3 ("EROICA")
Cleveland Symphony Orchestra conducted by George Szell. Epic LC5385. Price $3.98.

This recording of the great "Eroica" will be of interest to music students and anyone else who would hear this work about as free of mannerism and hewing-to-the-letter-of-the-score as possible. Szell conducts the work in a most pedantic fashion, leaving matters of interpretation to others. While a hearty respect for a composer's written score is admirable, it can be carried to extremes. Toscanini was respectful of the composer's intent, but note perfect though his performance might be, it also carried the spark of life and greatness. Toscanini dug beneath the score and looked at the composer as a man and tried to understand what the man wanted to say. Therein lies the difference in this performance. It is like a beautiful marble statue . . . very lovely to look at, but after all . . . just cold and soulless stone. Nor is there saving grace here in matters of sound. Generally it is good, clean sound, but it does not have the rich opulence available in several other versions.

SCHUMANN
SYMPHONY #1 ("SPRING")
SYMPHONY #4 IN D MINOR
London Symphony Orchestra conducted by Josef Krips. London LL1736. Price $3.98.

A good coupling and a good value, this disc is noted for the excellence of its sound and the fine orchestral playing. Krips turns in a pair of performances which are better than most in the LP catalogue, but which are surpassed by several others. If I were to categorize his readings, they would come under the heading of competent but bland. A little more purpose and drive would have helped greatly. As stated, the chief value is in the sound, which is very much "big-hall" with fine live spaciousness and bright clean definition. Lovely edgeless string tone is coupled with very pure-toned woodwind and brass which is brilliant but not blatant. With fine balance and wide dynamics added, the sonic whole is impressive on a big rig.

ELGAR
FALSTAFF (SYMPHONIC STUDY)
COCKAIGNE OVERTURE
Philharmonic Promenade Orchestra conducted by Sir Adrian Boult. Westminster XWN18526. Price $3.98.

"Falstaff" is one of Elgar's lesser-known works, which has never had marked attention from the recording companies. And yet what a wealth of interesting material they have been overlooking! Those of an inquiring nature will find this to be a rewarding listening experience, especially in this excellently performed, fine sounding version.

The only other recording in the LP catalogue is the Anthony Collins reading on *London* and while it had its virtues both sonically and in performance, it is not quite the measure of this disc. Sir Adrian has a little more insight into the score than Collins and brings out more of the drama and humor in the work.

HOLST
THE PLANETS
Los Angeles Philharmonic Orchestra conducted by Leopold Stokowski. Women's voices of the Roger Wagner Chorale. Capitol P8389. Price $4.98.

This is yet another of those perplexing new recordings Stokowski has been making for *Capitol*. Frankly, I'm so darn disappointed so far, I could cry. I expected great things when the Maestro moved to *Capitol*. I looked forward to brilliant new recordings of many of the works that Stokowski had made famous over the years. I have always had great respect for *Capitol* sound and was confident we would be getting some really outstanding recordings. What has gone wrong I don't know, but as I said in my review of the first Stokowski/*Capitol* recording it just doesn't seem like the kind of sound the Maestro would pass.

This present recording is almost heartbreaking. The "Planets" is one of Stokowski's red hot specialities and on this disc is the finest performance ever. The sheer virtuosity of the conducting is breathtaking. Section after section of this huge work, unfolds with delight piled upon delight. The phrasing, dynamics, every facet is burnished to bright perfection by the Maestro. But the sound . . . ! There is a great deal of very good sound on the disc, especially if you take the various instruments individually. Most of it however is in the middle and high registers. The continuing problem is in balance and in bass response. The orchestra sounds impossibly weighted on the treble side, with no real bass foundation. This results in a very thin, bodiless sound not at all typical of either Stokowski or *Capitol*.

In my own humble opinion, I feel that the miking is not done close enough. Generally, if you get a good close-in mike pickup, you can combine this with enough hall reverb to lend great "liveness." Now if you mike the orchestra at a distance and still add reverb, the sound becomes formless. My ear tells me there is indeed too much reverb here and there is a lack of sonic focus and sharp detail. To anticipate your questions, I have had my sound system minutely checked and everything is OK. I have several thousand dollars of the finest audio equipment available and all other discs sound normal on the rig. It's beyond me, so I give up! As noted, if you can stand the imbalance of sound, this is *the* premier performance. —30—

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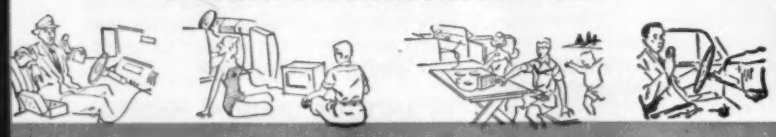

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6C-RMF (6/12 volts) 60 to 80 watts. Shipping weight 12 lbs.
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List Price..$49.50

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MODELS

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MODELS

Model 300 (Floor Model) as illustrated above. 115 volts A.C. Shipping weight 2 lbs.
DEALER NET PRICE.....$4.63
List Price....$6.95

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DEALER NET PRICE.....$3.30
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* ADDITIONAL MODELS AVAILABLE

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MODELS

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DEALER NET PRICE.....$42.95

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DEALER NET PRICE.....$59.95

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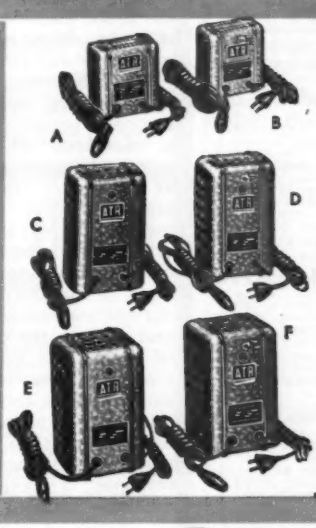

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E—12CA10 (10 amp.) 12 volts Shipping weight 9 lbs.	DEALER NET PRICE $24.71 List Price.....$32.95
B—612CA4 (4 amp.) 6/12 volts Shipping weight 6 lbs.	DEALER NET PRICE $14.21 List Price.....$18.95
D—612CA6 (6 amp.) 6/12 volts Shipping weight 8 lbs.	DEALER NET PRICE $20.96 List Price.....$27.95
F—612CA10 (10 amp.) 6/12 volts Shipping weight 10 lbs.	DEALER NET PRICE $27.71 List Price.....$36.95

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Spot Radio News

(*Continued from page 18*)

military version of the *Sikorsky* S-58, is equipped with a mass of instrumentation including high-frequency, very-high frequency, and ultra-high frequency communications, tacan, omnirange and distance-measuring equipment, instrument landing system receivers, and automatic direction finders.

A PORTABLE, battery-powered, 50-cps to 100-kc. transistorized microammeter, with a 200-microammeter (full scale), has been developed by the Bureau of Standards. Current pickup is a miniature split-core transformer that can be clamped onto a wire, making it unnecessary to open the circuit to make a measurement.

For many years, it has been common practice to extend the range of current-indicating instruments by using current transformers. For convenience, the transformer often consists of a secondary winding on a split core that can be clamped around the conductor carrying the current to be measured. This technique suggested a similar device for measuring small currents at audio and radio frequencies; an instrument consisting of a small clamp-type magnetic probe and a suitable means for amplifying the probe output to operate an indicating meter. Such an instrument would be complementary to the vacuum-tube voltmeter found in laboratories. The Bureau's device is not only based on the probe-amplifier-meter concept, but it is transistorized for long life and modest power requirements.

The circuit features a preamplifier consisting of two transistors and a feedback network. Gain in this stage is sacrificed to provide frequency equalization and to reduce phase shift at the higher frequencies. A pair of transistors are used in two intermediate stages, using direct coupling. A feedback network, from the emitter of the second transistor to the base input of the first, stabilizes the direct-current operating point for each pair and reduces the over-all current gain of each stage to about 20. The a.c. feedback factor at low frequency for each stage is about 100; the low-frequency current gain is thus stabilized against transistor and battery aging and the frequency range for constant response is extended beyond that available without feedback.

THOUGH U.H.F. has been shunned by many, one enterprising operator in the New England states has found the higher channels to his liking.

WWLP in Springfield, Massachusetts, operating on channel 22, is using low-powered translators effectively to fill in shadow areas and provide service to over a million in the Connecticut River valley.

AS WE WENT to press, the stations listed on page 14 of this issue received authorization to go on the air.

THE ELECTRON microscope is now being used as a research tool to study wood technology.

A new powerful model, which can detect particles smaller than one ten-millionth of an inch, magnify them 50,000 times, and produce electron images so photographically sharp and detailed that they can be enlarged more than 300,000 times, has been installed in the College of Forestry of the State University of New York. At this enlargement scale, a quarter-inch wood splinter would appear as an object nearly two miles long.

IN ANOTHER UNUSUAL application of advanced electronic techniques, 40-megacycle signals, bounced from meteor trails 60 to 100 miles above the earth, have been used to transmit images of printed material over a distance of nearly 1000 miles without relays.

The test was conducted recently between a transmitting station at Havana, Illinois, operated by the Bureau of Standards and *RCA's* research installation at Riverhead, Long Island. The novel system was developed for the Cambridge Research Center of the Air Research and Development Command.

In meteor-trail propagation, when a meteor enters the thin upper atmosphere of the earth, the high velocity of its passage causes the air particles to break down into positive and negative ions. This trail of ionized air, which may persist during a time interval ranging from one-tenth of a second up to several minutes after the passage of the meteor, acts as a reflector of radio signals which would otherwise radiate out into space. Along a transmission path of the type used in the experimental facsimile system, ionized meteor trails appear on an average of several times a minute to close the circuit between the transmitter and the receiver.

In the present system, material to be transmitted is recorded on 35-millimeter film, which is scanned to produce a signal in a manner similar to the techniques used in TV-film transmission. The resulting signal is sent out from the transmitter through a highly directive antenna aimed in the direction of the distant receiver. At the receiver, the signal is picked up by another directive antenna each time it is reflected during the brief life of an ionized meteor trail and the information is fed to a cathode-ray tube for display on a viewing screen. The scanner and the transmitter are run continuously, sending copies of a picture over and over at a rate of two complete scans each second.

Once more electronics has demonstrated its spectacular properties as a tool of the scientist—to mold a brighter future for mankind. . . L. W.

Retrace Blanking Troubles

(*Continued from page 67*)

Leakage from other terminals at the CRT, leakage of the video coupling capacitor, etc., may cause this condition.

Lines with Dark Pix

Where the blanking pulse is applied to the cathode of the picture tube, leakage to the tube through the blanking network, instead of causing retrace lines with brighter-than-average image, can cause retrace lines to appear with a relatively dark picture. As in the preceding case, test to see whether the blanking network is at fault by disconnecting it. If the darkening clears up, the trouble is probably in the blanking network. If it persists, check for leakage at other points already suggested in the preceding example.

Blanking Amplifiers

Sometimes the blanking pulse is amplified before it is applied to the CRT. Such a vertical-blanking amplifier is shown in Fig. 6. Where difficulties arise in such a configuration, of course, the tube itself is an early suspect. As with any amplifier, voltage and resistance readings in the stage may also be helpful. Of course, one may also check for presence of the pulses at the appropriate points. Waveform *A* should be found at point *A;* waveform *B* should be found at point *B* and again, amplified and inverted, at point *C*.

When a blanking pulse is to be applied to the first anode or focus electrode of the CRT, we are dealing with electrodes where the voltage is much higher than it is on either control grid or cathode. Accordingly, any blanking pulse that is to be applied at such electrodes must also be of considerably greater amplitude to be effective. It is for this reason that a blanking amplifier like that in Fig. 6 must be used. Voltages at the grid and cathode of such a stage tend to be critical. Here they are set by a voltage divider consisting of R_{B1} and R_{B2}. Any appreciable discrepancy should be adjusted by using resistors of close tolerance (5%). The plate circuit is also somewhat critical, but less so. Adjustment of resistors within 10% is acceptable.

The remaining components perform more or less the same functions as in the more simple circuits. Their tolerances are not too critical, but 10% replacements are advisable.

Note that the "B+" supply is from the "B boost" in the horizontal circuit. It must be delivering the correct value or the blanking circuit can be upset. Also, in some circuits, the vertical oscillator is supplied from the same source through a common resistor, as is the case here. A gassy vertical-oscillator tube can cause retrace-blanking failure by dragging down the applied "B+" to the blanking circuit. The fault shows as low "B+" at the vertical oscillator as well as the blanking circuit. –30–

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PORTABLE AUDIO AMPLIFIER—1141F. Used with 625 mine detector. Compl. w/tubes, schem., cable. L.N. 12 x 4 x 4. 9 lbs. $3.95
LO-PASS CONSTANT K Type. 3 section. Transmission line filter #CW53155. Provide max. atten. 6½ x 1½ x 1½. $1.95
TORSIONAL RELAY—Wallace & Tierman Frequency selective. For use in applications where radio waves are control medium. $3.95
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G. E. METER—2½" rd, 0-500 mils. .New $2.95
METER: 0-1 Mil (3KV scale) 3½" rd, Marion —new $3.95
FREQUENCY METER—T45/APM-3. 115V, 60-80 cy. input. 9300-9450MC. Can be used as a CW or Pulsed Signal Generator. Brand new. With Tech. manual. $79.95
FREQ. METER—Weston 814 (4½" Rd) 100-125V 380-420CPS (40 Div). $14.95
CROSS POINTER Landing Indicator—type CAY-22316. New. $6.95
MIN. CARBON BUTTON MIKE—C-1 (ANB-MC1) w/plug. Br. new. 6 for $5.00. . . . . ea. $1.00
PANORAMIC ADAPTER—ROP—5" screen—115/230V 55/65 cy. w/all tubes. Exc. cond. 60 lbs. $49.95
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INTEGRATOR TUBES: 6107/BS212 or 6108/BS213—worth over $10.00. . . . ea. $2.95
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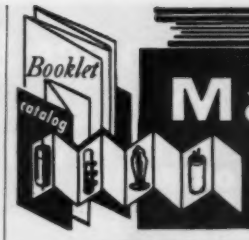

Manufacturers' Literature

SYLVANIA BOOKLETS

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has announced publication of two new booklets of interest to the industry.

Entitled "Industrial Tubes" and "Guide to Replacement," the new publications are designed as source material for distributors and users of industrial electron tubes. The first booklet describes the general characteristics of vacuum power tubes, beam power tubes, rectifiers, thyratrons, magnetrons, mercury vapor rectifiers, and ignitrons. It also lists the maximum ratings of these types. In addition, there are sections devoted to reliable and ruggedized tubes.

The second booklet lists the basic designation, tube class, and various manufacturers' type numbers for over one hundred tubes in *Sylvania's* industrial line.

Either or both of these booklets are available from the manufacturer without charge on request.

"VIKING" HAM EQUIPMENT

E. F. Johnson Company of Waseca, Minn., has issued a new 28-page catalogue featuring photos, schematic diagrams, and detailed descriptive data on its "Viking" line of amateur equipment and accessories.

Free copies of Catalogue #957 are available by writing William E. Bruring, W9ZSO, advertising and sales promotion manager of the company.

PANEL METER DATA

Ideal Precision Meter Co., Inc., 126 Greenpoint Ave., Brooklyn 22, N. Y., has released a new 4-page catalogue covering its latest styles and ranges of panel meters in sizes from 2⅛" to 7¼".

Catalogue C-22 carries complete specifications on all d.c. types and includes dimensional diagrams, typical scales, and data charts. Featured are three new modern clear plastic models, the 212P, the 250P, and the 725P. Photographs are lavishly used in the publication.

For a copy of Catalogue C-22, write on your company letterhead direct to the manufacturer.

RESISTOR COLOR CODER

General Cement Mfg. Co., 400 S. Wyman St., Rockford, Ill., has issued a carbon resistor color coder which will be of help to service technicians, students, and hobbyists.

The handy gadget will allow anyone to read carbon resistor color codes immediately. It works on the slide rule principle where the indicators on the slide are set opposite the colors in their order. The value of the resistor is read through associated windows in the center of the card.

The color coder measures 3"x3¼" and is sturdily constructed. Colors are printed on a white background for easy identification and the printed portion is extremely easy to read.

The unit, catalogued as No. 5230, carries a list price of 25 cents and is available from parts jobbers.

TWO NEW EIA STANDARDS

Electronics Industries Association (formerly RETMA) has released two new standards of interest to the industry.

RS-196 covers fixed film resistors of high stability while RS-197 lists standardized specifications for power filter inductors for electronic equipment. The first publication, a 6-page pamphlet, is priced at 60 cents while the second, also a 6-page booklet, is listed at 50 cents a copy.

Either or both of these new standards may be ordered from the Association's Engineering Office at 11 West 42nd Street, New York 36, N. Y. Payment should accompany orders.

CENTRALAB "PEC" GUIDE

Centralab, a division of *Globe-Union Inc.*, 900 E. Keefe Ave., Milwaukee 1, Wis., has just issued a new 12-page guide which contains schematics and specifications on all 96 of the firm's "PEC" units.

The guide contains a complete cross-reference section which lists the manufacturer's part number of all packaged circuits used by 130 radio and TV manufacturers since 1949 and the corresponding *Centralab* replacement. There is also a section containing the proper test procedure for checking all of these packaged electronic circuits.

Guide No. 4 is available from the company's distributors or by writing the manufacturer direct.

"PROFIT BUILDERS" CATALOGUE

The Advertising and Sales Promotion Department of *RCA's* Electron Tube Division, Harrison, N. J., has issued a colorful new "Profit Builders" catalogue which lists the company's sales promotion aids for radio-TV service dealers and technicians.

The 24-page catalogue, which is available from the firm's distributors, describes and illustrates more than 130 sales promotion, business, and technical aids for the use of service dealers and technicians in building prestige and profits.

Items in the catalogue range from a

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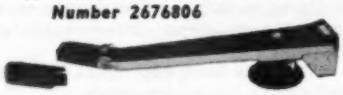

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NEW MODEL of the FM tuner that received rave reviews in top audio magazine and reports! Attach to any amplifier, console or TV set. Compact 9⅝ x 4⅜ x 6⅛" size. 20-20,000 cps response, Armstrong-type FM

Introductory Sale!
$5 Down, $5 Monthly **$47.50**

REALISTIC® Speakers

$19.95

2 FOR STEREO Sale, 2 for $37.50

14½ x 11 x 10½" In Cabinet!

Fabulous "Solo", a compact dual-cone speaker complete and installed in its solidly-built mirror-finished mahogany case! Finished on FOUR sides. Includes runner feet. Tuned, vented duct-type Helmholz resonator. 50-14,000 cps, matches 4-8 ohms. *Made to sell for $37.50.*

REALISTIC® Tape is GSF*

**Guaranteed Splice Free*

1200' Guaranteed Splice Free Tape

7" reel, plastic base, exclusive Magne-Gloss highly polished oxide coating. *Regularly $3.39.* **$1.79**

1800' Guaranteed Splice Free Tape

7" reel, as above except 50% MORE playing time due to 1 mil. thickness. *Regularly $4.98.* **$2.69**

Mail Coupon NOW!

Radio Shack Corporation
167 Washington St., Boston 3, Mass.

Please send me:

	Description	Net*	Order No.	Ship. Wt.
☐	Speaker	$19.95	R-9036	12 lbs.
☐	Two "	$37.50	R-9036-2	24 lbs.
☐	16" Arm	$19.50	R-6602	5 lbs.
☐	12" Arm	$14.95	R-8148	4 lbs.
☐	Amplifier	$29.95	R33-303	10 lbs.
☐	FM Tuner	$47.50	R36-888-2	10 lbs.
☐	Turntable	$64.50	R-7903	16 lbs.
☐	" System	$97.50	R-7903SYF	30 lbs.
☐	1200' Tape	$1.79	R-8212	1½ lbs.
☐	1800' Tape	$2.69	R-8118	1½ lbs.
☐	More data on:			
☐	FREE 64-page Hi-Fi Buying Guide		#59-R	

*Introductory sales prices for limited time

My Name _____
Street _____
Town _____ Zone ____ State ____

RADIO SHACK CORP.

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Stores: BOSTON, and 230 CROWN ST., NEW HAVEN, CONN.

Quick, Easy Access to Your MINIATURE CHASSIS With XCELITE'S Handy Pocket NUTDRIVERS!

XCELITE POCKET NUTDRIVERS
Available in your four most-needed sizes: 1/8", 1/4", 5/16" and 3/8" Hex.

Today's Increasing Miniaturization

prompted XCELITE to bring you these **Super-Handy** Pocket Nutdrivers with the convenient pocket clip.

You'll want to keep **all four** of these "just-right-hex-size" XCELITE Pocket Nutdrivers clipped in your shirt or coat pocket. They're ideal to reach those "hard-to-get-at" places in the new miniature and sub-miniature sets.

Fact is, XCELITE Pocket Nutdrivers are just like all the other **quality** hand tools in the line—XCELITE screwdrivers, regular nutdrivers, pliers, reamers, adjustable wrenches, kits. All XCELITE tools are precision-made especially for professional Radio, TV, Hi-Fi and Electronics Servicemen. Remember, XCELITE always brings you the **finest** tools **first!**

Call or See Your Dealer Today!

Order all four of these time-saving, work-saving XCELITE Pocket Nutdrivers. And, while you're at it, check your needs and order all the XCELITE Tools that will help you do your job better, quicker, more profitably!

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FOR
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for construction of
RF type High Voltage
DC POWER SUPPLIES

35 KV COIL

Coils are furnished with schematic diagrams showing various circuits, regulated and unregulated, of DC power supplies from 5 KV to 90 KV.

5 KV	$ 7.00
10-15 KV	12.00
25 KV	36.00
35 KV	42.00
70 KV	75.00
Filament Transformers	$1.50

All prices are Net

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SPELLMAN TELEVISION CO., INC.
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NOW . . . Check Vibrators In ANY Tube Checker

SENCORE "VIBRA-DAPTOR"

Another Sencore Time-Saver

MODEL VB-2

2 ADAPTORS IN 1

Checks Both Three and Four Prong Vibrators

- Merely plug into any tube checker. Set for 6AX4 (or 6SN7) for 6 Volt Vibrators and 12AX4 (or 12SN7) for 12 Volt Vibrators.
- Two lamps viewed through top of adaptor indicate whether or not Vibrator needs replacing. • Rugged — Made of steel. • Replaceable but unbreakable #51 indicating Lamps. • Operates easily with Sencore LC2 Leakage Checker. • Complete instructions screened on front.

ONLY $27.75 DEALER NET

At leading distributors everywhere

MANUFACTURED BY
SERVICE INSTRUMENTS CORP.
171 OFFICIAL RD. ADDISON, ILL.

POPULAR SENCORE PRODUCTS
- Transistor Tester
- Leakage Checker
- Filament Tester
- Handy "35"
- Vibra-Daptor

giant outdoor illuminated sign to decals which identify the authorized dealer of *RCA* electron tubes. The publication also gives details on an assortment of color-TV service promotional aids, display material, direct mail and giveaway literature, newspaper ad mats, TV and radio commercials, technical literature, and advertising specialties.

DATA ON SERVICE PARTS

Workman TV Inc., 309 Queen Anne Road, Teaneck, N. J., has issued two new data sheets of interest to the service field.

One sheet covers exact replacement resistors for use in transistorized auto radio output circuits, while the second provides full specifications on the firm's Model #D1 "Adapt-it" for use with the new *RCA* type 110-degree TV picture tubes. The adapter converts the base of the 110-degree tube to that of the standard duo-decal type so that all existing harnesses and test equipment for standard duo-decal picture tubes can be used.

Write the company direct for either or both of these data sheets.

NEDA SPEAKER ROSTER

The national office of the National Electronic Distributors Association, 343 S. Dearborn St., Chicago 4, Ill., has issued a directory of speakers on electronic subjects for use by NEDA chapters and educational seminars.

Designed to be of help in making up programs, the directory lists speakers by company affiliation, subjects, geographical areas preferred, advance notice required, and minimum audience.

This project is designed to serve as a bridge between manufacturers' personnel who have something worthwhile to say and the audience they are trying to reach. Revision of the directory will be a continuing process and manufacturers are urged to furnish names of speakers for inclusion in future editions.

FREE LAMP CHART

A special industry-wide chart on panel and flashlight lamps has been compiled by *United Catalog Publishers, Inc.*, 60 Madison Ave., Hempstead, N. Y. and is being offered free to interested industry personnel.

The new chart is a composite listing, arranged numerically, of all panel and flashlight lamps manufactured by *Chicago Miniature, G-E, Eveready, RCA, Raytheon, Tung-Sol,* and *Westinghouse.* Simply by checking the lamp number the user can determine at a glance the respective manufacturer, bulb type, base, volts, amps, and bead color. All bulb types are illustrated with physical dimensions.

The company is publisher of "The Radio-Electronic Master," the 1958 edition of which has just been released.

"PETTI-SEL" RECTIFIERS

Radio Receptor Company, Inc., 240 Wythe Ave., Brooklyn 11, N. Y. has issued a new bulletin giving ratings and dimensions for its new high-cur-

rent-density "Petti-Sel" industrial type selenium rectifiers. The bulletin also has data on uprating the rectifiers when cooled by forced air.

A life of at least 100,000 hours is claimed for the industrial type "Petti-Sels" used according to the ratings indicated in Bulletin No. 248A, a copy of which is available without charge.

INDICATOR LINE

Eldema Corp., 1805 Belcroft Ave., El Monte, Calif. has just published a new brochure which covers a complete line of miniature indicator lights and special-function indicators for aircraft, computers, and industrial and laboratory instruments.

A transistor circuit indicator containing a diode network which adapts transistor voltages to fire a neon lamp is one of the featured items of this publication. The 6-page, two-color brochure includes photos, descriptions, and dimension drawings plus a sectional drawing showing general construction.

RACKS AND CABINETS

Par-Metal Products Corp., 32-62 49th Street, Long Island City 3, N. Y. is now offering copies of its new product catalogue which contains illustrations, descriptions, technical specifications, and prices on an extensive line of universal cabinet racks and utility desk assemblies.

Catalogue 58 also lists accessories and fittings used in conjunction with the basic housings. This 28-page catalogue will be supplied without charge on request.

OLSON FLYER

Olson Radio Warehouse, 260 S. Forge St., Akron 8, Ohio is now mailing out copies of its 28-page flyer which lists literally hundreds of unusual values in all types of electronic equipment.

Included are speakers, record changers, tools, timers, radio receivers, tape recorders, service parts, tuners, preamps, amplifiers, audio accessories, test equipment in factory assembled and kit form, motors, TV accessories, shop supplies, tubes, wire, etc. The flyer also lists premiums which buyers can obtain by saving the coupons which are given with purchases from the company.

Those who haven't received a copy of the flyer may write the company for one. It is available without charge.

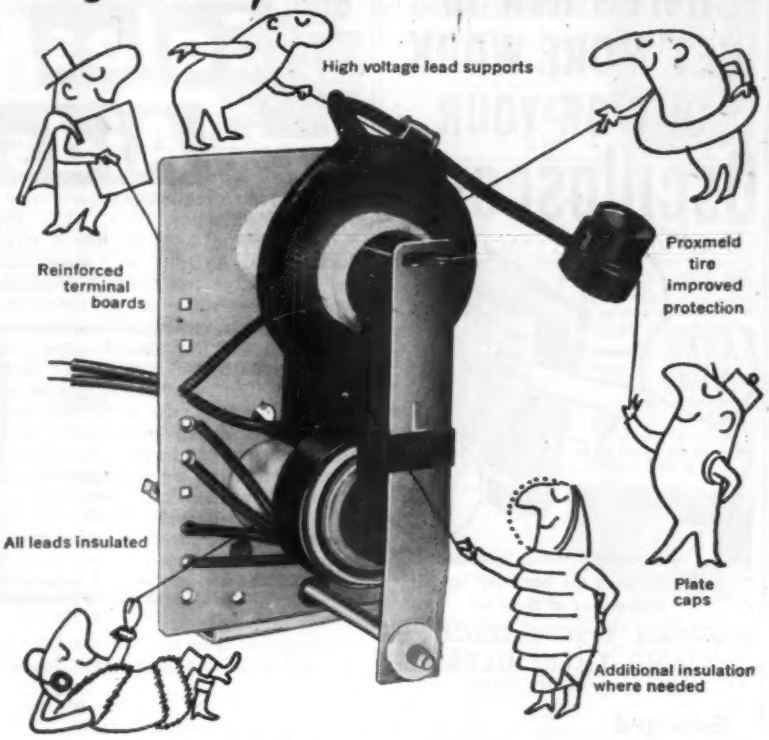
1958 RCA POCKET BOOK

The 1958 edition of the *RCA* Reference Book is now available from the company's distributors.

Published annually since 1931, this pocket-size book contains 216 pages of up-to-date information on *RCA* electron tubes, test equipment, batteries, transistors, and semiconductor diodes. The data has been carefully selected to be useful to design engineers, service technicians, and purchasing agents.

The book has interchangeability directories for tubes, transistors, and batteries. It also contains a daily reminder calendar and 16 pages of world maps in color. —30—

You get these *plus* features with STANCOR



Stancor, the pioneer in the field of exact replacement flybacks, now goes one step further. The Stancor replacement represents an *improvement* over the original manufacturer's units. Additional features—like those above—are added when necessary to insure optimum performance. Stancor flybacks are engineered and improved replacements to help make your work more efficient and more reliable.

FREE —a new 100 page TV Replacement Guide with a brand-new format. Locates the replacement immediately—with or without the original part number. Models listed individually in numerical order. See your distributor or write us for your free copy.

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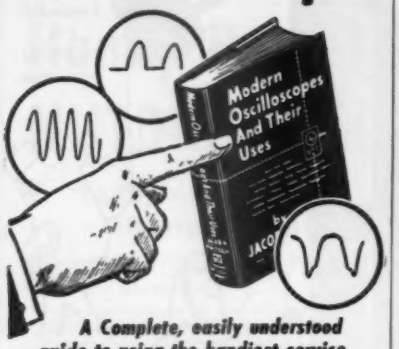
Here's how to GET MORE WORK OUT OF YOUR Oscilloscope!



A Complete, easily understood guide to using the handiest service instrument of them all

MODERN OSCILLOSCOPES AND THEIR USES

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Enlarged 2nd Edition

. . . contains the latest data . . . everything you need to know about 'scopes!

MORE THAN 30 NEW PICTURES

. . . plus 50 more pages on use of 'scopes in Color TV servicing . . . Industrial Electronics . . . Teaching . . . even in Atomic Energy work.

Oscilloscopes are gold mines for servicemen who learn to use them fast, fully and accurately on all types of work—and here is a new, enlarged 2nd edition of THE BOOK THAT REALLY SHOWS YOU HOW.

In clear, easily understood terms, it teaches you when, where and exactly how to use the oscilloscope . . . how to interpret patterns . . . how to use your 'scope to handle tough jobs easier, faster, and better.

It contains no involved mathematics—no complicated discussions. Instead, it gets right down to "brass tacks" in explaining how oscilloscopes operate. Then you learn exactly how to use them in lab work and on all types of AM, FM and television service—from locating troubles to handling tough realignment jobs.

'SCOPES ARE "GOLD MINES" . . . When You Learn to Use Them Right!

Each operation is explained step by step. You learn to determine just where and how to use the 'scope on specific jobs; how to make connections and adjust circuit components; how to set the controls; and HOW TO ANALYZE OSCILLOSCOPE PATTERNS fast and right.

370 illustrations including dozens of pattern photos make things doubly clear.

No other type of specific service training can mean so much to you in boosting your efficiency and earning power! Send coupon NOW for 10-day examination!

'SCOPE EXPERTS get better jobs . . . bigger pay!

PRACTICE 10 DAYS—FREE!

Dept. RN-28,
RINEHART & CO., Inc.
232 Madison Ave., New York 16, N. Y.

Send MODERN OSCILLOSCOPES AND THEIR USES for 10-day FREE EXAMINATION. If book is satisfactory, I will then send you $6.50 (plus postage) promptly in full payment. If not, I will return book postpaid in good condition and owe you nothing. (SAVE! Send $6.50 cash with order and we pay postage. Same 10-day return privilege with money refunded.)

NAME .....

ADDRESS .....

CITY, ZONE, STATE .....

OUTSIDE U.S.A., $7.00 cash only. Money back if you return book within 10 days.

JFD "SELL-A-BRATION"

JFD Electronics Corp., 6101 16th Ave., Brooklyn 4, N. Y. has a large-scale "Sell-A-Bration" sweepstake sales incentive program underway which will continue until March 31st.

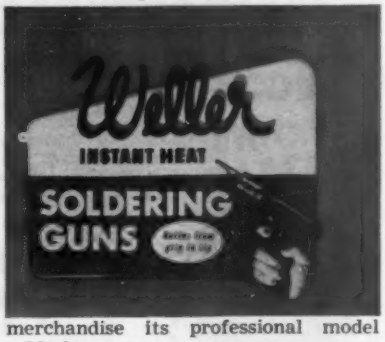
Each service-dealer will receive certificates good for brand-name merchandise with the company's "Colortennas." The selection of prizes embraces over 1000 gifts as well as pleasure trips. Grand prizes are to be awarded, over and above these incentives, consisting of all-expenses paid trips for two to Paris, Bermuda, and the Waldorf-Astoria Hotel in New York, to the three service dealers earning the highest number of certificates. The winners will be announced May 19 at the Electronic Parts Show in Chicago.

Information on the "Sell-A-Bration" promotion is available from the company.

* * *

"3-D" WELLER SIGN

Weller Electric Corporation of Easton, Pa. has developed a multi-use, three-dimensional sign in four vivid colors to help electronic distributors



merchandise its professional model soldering guns.

The display may be mounted for framing, to give added size to the sign in large display areas; hung on a wall by using tacks or nails in side tabs with holes; set up on counters; or attached to display cases.

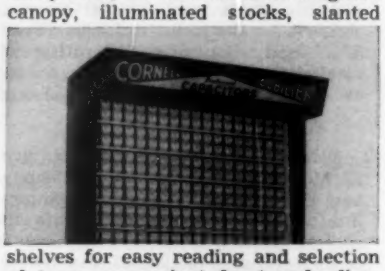
The plastic sign, which is red, yellow, white, and black, features a soldering gun and appropriate selling copy. The sign measures 22" long, 17" high, and less than 2" thick. It is available to distributors without charge.

* * *

SELF-SERVICE CAPACITORS

Designed for easy self-service and maximum display value, the new floor racks for distributor establishments offered by *Cornell-Dubilier Electric Corp.*, South Plainfield, N. J. are proving exceptionally effective in merchandising the firm's "preferred-type" twist-prong electrolytics.

Each single-section rack with canopy holds 360 cartons or 720 cartons for the dual-section unit. Finished in blue and yellow, the rack features a lighted canopy, illuminated stocks, slanted



shelves for easy reading and selection of types, convenient front re-loading, and no "blind stock," making self-inventory a simple matter.

* * *

PENTRON STEREO DISPLAY

A new demonstration center display for stereo and monaural tape components is now available from *Pentron Corporation*, 777 S. Tripp Ave., Chicago 24, Ill.

The display is made of ¾" plywood and the natural finish of the wood is lacquered and silk-screened. The dealer may use the display as offered or it can be painted any color to match the store decor.

The unit accommodates a tape mechanism and three flush-mounted tape preamplifiers. The customer can easily select the stereo and hi-fi units he desires since all units are operative in the display.

* * *

WIRE PROCESSING FILM

Eubanks Engineering Company, 260 N. Allen Ave., Pasadena, Calif. has produced a 15-minute 16 mm. color motion picture on its new automatic wire cutter and stripper which is being made available to interested groups on a loan basis.

Entitled "Modern Wire Processing," the film shows in detail the action and operation of the machine which will cut and strip 12 to 32 gauge insulated wire in lengths from 1 inch to 300 feet at speeds up to 8000 pieces an hour.

* * *

"CONTROL-MASTER" TESTER

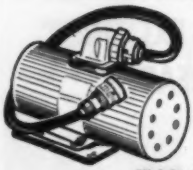
Packard-Bell Electronics Corp. of Los Angeles has come up with a unique "shopper stopper" which enables customers to test its new "Control-Master" television remote control unit.

With the unit mounted on a display, the shopper may change channels on a nearby *Packard-Bell* demonstration set, turn the set on or off, adjust picture brightness, fine tuning, and volume control. In addition, the customer can switch the sound from the set to the self-contained speaker in the control unit for personal listening. —30—

TERRIFIC BUY!

RADIO DYNAMOTOR

Type DY-25/AXT-2



Input:
26.5 V.D.C. @ 25 A.
Output:
775 V.D.C. @ .225 A.
405 V.D.C. @ .035 A.
−53 V.D.C. @ .050 A.
18.3 V.A.C. @ 3.7 A, 95 cy.

Complete with mounting base, cable and plugs, BRAND NEW in original packing **$7.95**

Weight 26 lbs.

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES Type	Description	Excellent Used	Brand NEW
BC-453	Receiver 190-550 KC	$12.95	$16.95
BC-454	Receiver 3-6 Mc	8.29	11.95
BC-455	Receiver 6-9 Mc	7.95	11.95
BC-456	Modulator	3.45	4.95
BC-450	3-Receiver Control Box	1.49	1.95
BC-451	Transmitter Control Box	1.25	1.49
BC-696	Xmtr 3-4 Mc (like new)	6.95	8.88

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.88**

BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW **$7.88**

BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. BRAND NEW **$11.95**

ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.88**

110 VOLT AC POWER SUPPLY KIT

For All 274-N and ARC-5 Receivers

Can be assembled quickly and easily, on pre-drilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. Complete kit of parts with metal case, instructions. Factory wired, tested, ready to operate **$7.95** **$11.50**

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only **49c**

McElroy Automatic KEYER

Suitable for keying transmitter, or for code practice. Has photoelectric cell and sensitive relay. Variable speed motor operates on 110 volts 60 cycles AC. complete with tubes, excellent cond., your cost **$16.95**

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Satchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 8 tubes. Size 4" x 4" x 6". Wt. 4 lbs.

BRAND NEW **$8.88**

Brand New, less tubes $5.95
USED, with tubes.. 5.95 USED, less tubes.. 2.95

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.
COMBINATION ..... Special **$33.33**

Receiver only, with all tubes $19.50
Transmitter Only, with all tubes $22.25
Accessories for above available.

DYNAMOTOR VALUES!

Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	2.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24

BD-77C DYNAMOTOR, input: 14 V DC @ 39 A. output: 1000V DC @ .35 A. With Filter. Like New! Special **$22.50**

FL-8 FILTER 79c

BC-442 ANTENNA RELAY

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator), 0-10 scale. Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW..... **$2.49**

BC-645 XMTR RECEIVER

15 Tubes 435 To 500 MC

BRAND NEW

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc. citizens radio 460-470 mc, fixed and mobile 450-460 mc. television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs. **$29.50**

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) ..... only **$7.95**

UHF ANTENNA ASSEMBLY, for BC-645 ..... $2.45

Complete set of 10 Plugs for BC-645 ..... **$5.50**

CONTROL BOX for above $2.25

SHOCK MOUNT for above 1.25

CONVERSION BOOKLET. Instructions for most useful surplus rigs **$2.50**

ARC-5/R28 RECEIVER

2-meter Superhet, 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes.
BRAND NEW **$20.45**
110 V AC Power Supply Kit for above $9.75

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. BRAND NEW **$19.95**

SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. BRAND NEW, less tubes..... $7.95
Excellent Used, less tubes..... $5.95

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**

BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Excellent Used **$11.95**
POWER SUPPLY for above, 117 V 60 Cycles AC. Excellent used $16.95

BC-603 FM RECEIVER, 10-channel push button tuning or continuous tuning, 20-28 Mc. Complete with speaker, tubes, squelch, 12-V Power Supply. Exc. **$14.95**

BC-683 same as above except 27 to 38.9 Mc. **$24.95**

RADIO RECEIVER NAVY TYPE RAY-3

Model AN-PRGN is for 14V DC operation. These receivers are supplied complete with built-in dynamotor, 11 tubes. Weston output meter on front panel, as well as coax antenna and output connection, phone jack, on-off switch.

WHILE THEY LAST—Our Price **$13.95**

234-258 MC RECEIVER

AN/ARR-2, BRAND NEW, tubes included: 7—9001, 3—6AK5, 1—12A6. Schematic included. Complete with 11 tubes, our low price **$9.99**

With 28 V, 1.6A Dynamotor, complete... $12.98
110 VOLT AC POWER SUPPLY KIT for above **$9.75**

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only $2.95

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special $3.95

HI-LO IMPEDANCE MATCHING TRANSFORMER for headphones. 600 ohms to 8000 ohms. With plug and jack. Instructions included. BRAND NEW. **97c**

HI-FI DYNAMIC HEADSET with Cushions

Freq. Range: 40-14000 CPS. No Distortion. BRAND NEW **$7.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$5.45	$7.95
T-30	Carbon Throat Mike	.39	.79
T-45	Army and Navy Lip Mike		1.33
T-24	Carbon Mike		5.95
TS-9	Handset		4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.25	$4.95
HS-33	Low Impedance	2.79	4.95
HS-30	Low Imp. (featherwt.)	1.49	2.25
H-16/U	High Imp. (2 units)	3.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack		.99

SCHEMATIC DIAGRAMS For any equipment on this page, each.. **50c**

Please include 25% Deposit with order—Balance C.O.D. 50c Handling Charge on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C.

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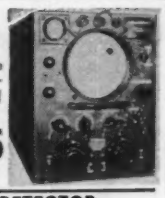

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Complete with batteries .....

MN26Y BENDIX DIRECTION FINDER

150-325 Kc; 325-695 Kc; 3.4-7 Mc. Complete with tubes, motor. **$26.95**
BRAND NEW .....
Used, like new, incl. tubes and dynamotor.. $18.95

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For commercial navigation on boats and planes. Complete installation comprises:
MN-26-C Receiver, used, with 12 tubes **$16.50**
MN-26-C With 12 Tubes, BRAND NEW $24.95
MN-20-E Rotatable Loop 4.25
MN-52 Azimuth Control Box 2.95
All necessary accessories for above in stock.

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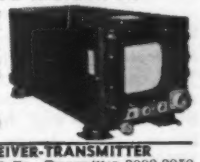

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Receiver 4 band 195-9050 Kc. Transmitter 3000-9050 Kc and 2300-4200 Kc. 28 V Dynamotor. ALL BRAND NEW, complete **$88.50**

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VR150	.79	1625	.26	12SA7	.34
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Service Dealers and Sales

(*Continued from page* 58)

sell service as a commodity at a price that will give us a profit. This will keep us exposed to the new-set business that has been falling in the laps of the specializing service shops."

Obviously, all TV set retailers eventually will have to re-appraise the service phases of their businesses. The continuing shortage of competent service technicians will make it necessary for dealers to pay competitive wages to get and keep good men. The recent action of department and specialty stores in San Francisco in accepting a three-dollar-per-hour rate of pay for TV technicians indicates the determination of dealers to maintain their positions in the service market. To operate a service department profitably when technicians are paid at that rate requires a minimum charge for home service calls of six dollars and twenty-five cents. The operation of dealer service departments on a profit-producing basis will have an important influence on creating a healthier business atmosphere for the entire TV service industry.

Another factor that will influence the thinking of retailers about developing their service departments more aggressively is the steady trend among part-time technicians to charge as much for their services as the full-time service dealers. Actually, many part-timers are reaching the conclusion that they provide a premium type of service, since they are available to repair sets during the hours when TV service shops may be closed. The result is that, except for the sharpies who advertise sub-standard charges as a gimmick to hook suckers, the public is being steadily educated in the wisdom of paying reasonable charges for TV service.

From a selling standpoint, it will become increasingly necessary for TV-appliance retailers to promote their service facilities and to make their service departments profit-producing facets of their businesses. Barring a revolutionary change in TV reception methods, neither cabinet design, nor appearance, nor circuit improvements will inspire the public to trade in operating old sets for new models. TV sets are bought for their utility as media of entertainment. Owners will use old sets until they are faced with the prospect of paying a big repair bill for a major overhaul job. The service technician on the job when the owner realizes the old set should be replaced is in the key spot to sell him a new set.

Thousands of service dealers have already become firmly entrenched in retailing TV sets. But they still promote service as the primary function of their businesses. While good service is the key to sales, the service requirements of TV make it imperative that service time, knowledge, and skill be sold at a profit. —30—

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Subliminal Ads Tried on TV

Hidden commercials are being studied by the FCC.

DURING recent months, a comparatively new advertising technique has been receiving considerable publicity. This technique uses the principle of "subliminal perception." The term, borrowed from psychology, refers to the fact that we are able to perceive or apprehend something even though we are not actually conscious of it through our physical senses. Hence, we are made aware of some bit of information by an appeal directly to our subconscious minds, without our being aware of seeing, hearing, or feeling the information itself. The method has already been tested with some success in the movies, where a special projector is used to flash a brief commercial on the screen for only 1/3000th second.

Since such brief exposures are not practical for TV, two other methods have been tried. In one of these the commercial is superimposed on the received program for as long as several minutes, but the brightness level is kept so low that the viewer is not conscious of it. This method has been tried only on closed-circuit TV, where its proponents have claimed some success. In a second method that has been tried over the air by an independent TV station, the subliminal ad is put on one frame out of 250 frames in a film loop. The commercial is sent out once every 11 seconds more or less steadily on some of the station's programs. Here again the ad is superimposed on the regular program. Results of this test have been inconclusive.

As a result of the public clamor and interest, the major TV networks as well as the National Association of Radio and Television Broadcasters, have issued statements on the subject of subliminal ads. In essence, the networks have forbidden the use of such techniques while the NARTB stated that the process should not be permitted on the television broadcast medium.

Because of Congressional protests, the FCC has undertaken a study of the technique as expeditiously as possible. Upon the completion of this study, the Commission proposes to "take such action as may be warranted under the circumstances." The Commission has further indicated that the problem is such that the public interest is not in immediate danger of being adversely affected. They feel that adequate proof has been given of the recognition by television licensees of their responsibilities and obligation to operate their stations in the public interest. -30-

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-30-

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Size 1½" x 2½" x 1⅝"

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$1.67 Ea. Stock No. X-694 3 for $4.50

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3 for $21.00 Stock No. AA-40 $7.60 EACH

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All About Audio

(*Continued from page* 57)

high premium in terms of amplifier watts, which cost money and involve bulky equipment.

We have ourselves often been astonished at the small increase in sound level in a concert hall which results from doubling the power. Using four 15-watt amplifiers, each 15 ohms output, in parallel, gives 60 watts when four 15-ohm speakers are switched on, also in parallel. With one speaker in circuit the available power is only 15 watts due to mismatch. Under these conditions, two speakers are better than one and four are better than two, but the total difference never *sounds* like 45 watts. The same argument applies in reverse under domestic conditions, where we can drop from 30 watts to 15 watts in amplifier output with little apparent sacrifice in sound. (The reader will notice I am careful to say "*we* can drop . . ." rather than *you*, because this viewpoint is more popular here than in the States!)

I admit that the margin of safety on the peaks shown in Fig. 35 is greater with a 30-watt amplifier than with a 15 watter, but I am assuming that the domestic levels of 3-5 watts on full orchestra—previously stated as adequate—will not touch 15 watts on transient peaks with drums and cymbals.

Measurement of Efficiency

This is even more difficult than rating power handling capacity. When I see it stated that the efficiency of horn-loaded speakers is 40% compared with 8% for reflex enclosures, and even as low as 2% for small infinite baffles, I can only conclude that the conditions of test do not even approximate the conditions of use, so the findings are of doubtful value to the average listener.

The question of where a test is made is of vital importance. For instance, if you work under free-field conditions and measure the output at the mouth of a horn you will obtain a maximum reading, but if an open baffle is used the reading in front of the cone represents only half the output which would be available in a live room. The reverberation time of the listening room also affects results—the longer it is, the greater the build up of sound, but this would not necessarily affect all speakers to the same extent.

The strongly directional properties of horn loading are too well known to need further emphasis, but if efficiency tests are made on-axis they do not apply if you listen 30° off-axis. In other words, directional properties have a lot to do with the question, and an omnidirectional speaker system rated officially as 8% efficient might give an average sound level in a normal listening room almost equal to horn-loaded types rated much higher. Part 9 of this series will deal with speaker mounting and response curves will

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show that these differences are not as great as one might expect, although it is clear that the totally enclosed cabinet filled with sound absorbents mops up half the sound produced by the cone, and reflex enclosures absorb much of the middle and upper registers.

Amplifier Output

The relationship between speaker efficiency and amplifier watts was clearly explained in the August 1957 issue of this magazine by N. H. Crowhurst in his excellent article on "High Power vs Low Power Amplifiers." The following quotation sums up the position very neatly:

"Take a 2% efficiency speaker in comparison with a 10% efficient speaker. Obviously, a 10-watt amplifier with a 10% efficient speaker will produce the same acoustic output into the room as will a 50-watt amplifier with a 2% efficient speaker. Both will give a maximum of just 1 watt into the room."

Mr. Crowhurst also said that the actual sound energy you need in the living room is only a matter of hundreds of milliwatts at the peak. I agree.

Load Matching

It is, I think, necessary here to repeat the warning that we only get 10 watts out of a 10-watt amplifier when it is correctly loaded. Amplifier makers belong to the more fortunate members of the audio industry; they provide a 15-ohm output and then make all their tests with a 15-ohm resistor across the terminals. No wonder they produce such wonderful results! I ask you, how many loudspeakers look like a pure resistance?

Mr. Cooke has already expatiated in Part 6 on the difficulty of matching electrostatic speakers to an amplifier and translating watts into sound without hidden losses. Many moving coil systems show a steep rise in impedance below 100 and above 2000 cps. It is easy to remember that a rise from 15 ohms to 30 ohms reduces 10 watts to 5 watts; nevertheless this is often forgotten. The virtue of a level impedance curve cannot be over-emphasized.

(To be concluded)

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Video Color Converter "Previewed" by Long Distance Phone

New Ampex video color converter revealed to TV stations and RADIO & TV NEWS *in phone call from firm's president.*

AMPEX gave the entire TV station network of the United States, Hawaii, and Puerto Rico a preview of the delivery and production plans on its video tape recorder recently in a series of long distance telephone calls.

President George I. Long of *Ampex Corporation* set a record for long distance telephoning by talking to 510 persons in 48 states and overseas.

The persons to whom Mr. Long talked were, for the most part, owners or managers of America's television stations. RADIO & TV NEWS also received a call from Mr. Long so that we could break the news to our readers. The calls were to announce *Ampex*' new tape recording equipment which will record and playback color television programs. The new gear is expected to be in production by June of this year.

"Conference" Calls Used

Long's call actually was a series of 22 "conference" calls during which he was heard by 24 persons at a time. His words were recorded on a tape recorder and played back into the telephone each time that another 24 listeners were connected by telephone operators across the country. Each call lasted approximately five minutes. Starting at 7:30 a.m., with 10-minute intervals between calls, the telephone operation required about 5 hours to complete.

Long talked first to cities in the eastern time zone and last to Pacific Coast cities and Hawaii. *Pacific Telephone & Telegraph Co.* said it was the most extensive use of its conference call service ever made by one person in one day.

New Color Adapter

Engineering on the new color adapter, which has been priced at $29,000 each, is being completed now. Two units have been promised to *CBS* for May, 1958 delivery. A segment of the industry is expected to wait until preliminary field tests have been conducted before ordering, but others are hastening to get their orders in to assure early delivery.

The new color converter will fit in a standard 19-inch rack mount. One section of the black-and-white electronics will be removed from the VTR and replaced by color conversion equipment. The balance of the equipment is designed to stand alongside the VTR in a single rack panel.

Ampex field engineers will assist TV station personnel in making the switch over from black-and-white to color. The company's officials claim conversion can be done in the field by station engineers. Complete instructions are included in a manual which accompanies the equipment.

Basically, the color converter records the entire color signal (which is different from the black-and-white signal) on a single channel continuous recording. The same head as used for black-and-white picture recording will be used for the color picture. The head will turn the same number of revolutions, but there will be a slight modification in the heads, for technical reasons.

"We will put strob marks on the rotating heads," explained Jack Hauser, company executive. "There will be a photo-sensitive device to synchronize the mechanical timing."

The *Ampex* videotape development, which may sound the death knell of kinescope film records, was first announced in April, 1956. More than 100 stations placed orders for the units at $45,000 each. Prototype models were put into active use by major TV networks the following November. KING-TV, Seattle, was the first television station to receive delivery of a production model.

Videotape is practically the same tape as is used in the average home recorder. Produced under exacting laboratory standards, the tape can be used approximately 50 times before quality deteriorates. Just as standard magnetic tape, used for audio or instrumentation recording, puts electrical signals on tape for later reproduction, VTR does the same.

It records the same kind of signal in much the same way, although the TV signal is made up of millions of separate bits of information per second.

With the recent agreement between *Ampex* and *RCA* to exchange patent rights on videotape recorders, standardization of equipment is assured. (*Ampex* and *RCA* are alone in the field at the present time). —30—

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Mac's Service Shop

(*Continued from page 68*)

"Open output filter capacitor," Barney guessed.

"Right. With the current-storing or bypassing action of this capacitor removed—whichever way you like to think of it—the plate circuit of the output tube could not get the strong pulses of current it demanded to supply power to a load. The whole thing acted like a transformer whose primary was being fed from a voltage source with poor regulation. When the secondary demand load increased, the voltage dropped.

"When this capacitor was replaced, everything worked fine; but I've been brooding ever since about how easy it is for a technician to forget what he knows especially when something or somebody gives his mind a push in the wrong direction."

"You know something?" Barney asked with a quizzical smile. "It makes me feel good all over when you make a mistake. What with you showing me up all day long here at the shop and then going home and watching those 'brains' on TV quiz programs coming up with answers that no one has any business knowing, I feel pretty stupid most of the time. It helps a lot when you pull a boo-boo."

"OK; so then I'll be big-hearted and pull some more," Mac promised with an understanding grin. "But I've been meaning to ask you if you are running into any unusual problems since channel 13 came on the air with that fine signal they're putting out?"

"Nothing too unusual. I'm pretty well convinced that everyone in this area should be getting 13 better than 8. On our own field-strength tests, 13 is putting in more than twice as much signal; so-o-o-o, when I hear someone say they are not getting it well, I work on the theory something is wrong in their set or installation, and there usually is."

"What's the most common difficulty?"

"Simply that the oscillator is not adjusted properly on channel 13. In many cases this channel was never set up in the beginning, since channel 13 was blank in this area for years; and in other cases the oscillator has just drifted off. At any rate, a simple twist with an alignment tool takes care of it."

"There must be other cases not so easily disposed of. At least you're away from the shop long enough."

"Oh there are!" Barney said hastily. "For instance, I've found that those people who insist on leaving a coil of surplus lead-in piled up on the floor behind the set may have been getting away with it after a fashion on channels 6 and 8, but channel 13 is another story. I chop out the extra lead-in, and if they insist on having it available so they can move the set around, I fix them up with a lead-in extension with connectors all

around so that it can be spliced into the line when needed or left out when not.

"Another thing I run across fairly often is one of those line-tuning gimmicks made of a piece of tinfoil wrapped around the line. This was adjusted so that 6 and 8 came in OK, but very often it cuts channel 13 way down. Usually I just take it off and throw it away. If the customer is the bullheaded type, I show him that it will have to be shifted up or down the line to get good reception on 13."

"Have you had any trouble from too much signal?"

"I was just coming to that. In quite a few instances the customer complains of picture pulling on channel 13 only. In most cases this is simply the result of overloading because the a.g.c. control is not properly set. Most of the sets in this ultra-fringe area are running nearly wide open most of the time. Re-adjusting the a.g.c. control normally sets things straight unless, of course, there's something wrong with the a.g.c. circuit itself."

"Well, you can say this for radio and TV servicing," Mac observed philosophically: "it is often a headachy, frustrating, maddening business, but it's never dull or boring. There's always something new coming up!" —30—

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FEBRUARY 8-11

Second Annual Midwest Electronic Forum. Sponsored by TSA. Hotel Statler, Detroit, Michigan. Additional information available from TSA, 8225 Woodward Ave., Detroit 2, Mich.

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1958 San Francisco High Fidelity Show. Sponsored by Institute of High Fidelity Manufacturers, Inc. and Audio Shows, Inc. Whitcomb Hotel, San Francisco.

FEBRUARY 20

Seminar "Practices of Tape and Disc Recording." Sponsored by Audio Engineering Society. Sessions to be held weekly for 15 weeks, Thursdays at 7:15 at RCA Institutes Auditorium, 350 W. Fourth St., New York City. Fee $35.00 for full course or $3.00 per lecture. Contact Sumner Hall at Amityville, N. Y., or MYrtle 1-7080 for full details or reservations.

FEBRUARY 26-MARCH 2

Audio Show. Sponsored by Institute of High Fidelity Manufacturers, Inc. Biltmore Hotel, Los Angeles, Calif. Additional details from Edwin Cornfield, Executive Secretary, 125 E. 23rd Street, New York 10, N. Y.

MARCH 24-27

1958 IRE National Convention. Waldorf-Astoria Hotel and New York Coliseum, New York City. Further details from E. K. Gannett, IRE, 1 E. 79th St., New York 21, N. Y.

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Sound on Tape

By BERT WHYTE

ABOUT the time the stereo disc was announced at the Audio Show, a sampling of opinion among the tape manufacturers present was that stereo disc would help, not hinder the stereo tape market and as far as they could see, it would be a peaceful co-existence. While for the most part this is probably true, only the most naive would fail to see the beginnings of strife. By this I mean that the parties involved are not going to sit around complacently waiting for a stereo disc to upset the tape market. Co-existence is possible . . . yes . . . but only as long as both media continue to sell strongly.

Tape is at an obvious disadvantage at the present time, due to the great price disparity. Even with an anticipated $4.98 to $5.95 tag on a stereo disc, the tape still can't compete pricewise. The tape boys are well aware of this and this fact has spurred activity in a field which had become almost static . . . the process of tape duplication. Get the cost of duplicating tapes down to a comparable level with discs and then go after the raw tape manufacturer. Show him how the new duplicating process can make recorded tape really a mass market item and the raw tape price will come down in a hurry.

As you probably know, most tape is duplicated today by multi-speed slave recorders or by the common mandrel system. These do a remarkably good job and they are constantly being improved upon, but still the process leaves something to be desired. Some years ago, pioneer work was done on a method of duplicating tape by a process analogous to photographic contact printing. A steel tape was used as the master and layers of raw tape were laid down over this master. Then a current would be applied to the master and bingo! . . . out comes "prints" of the master. If I remember correctly, fairly good results were obtained up to about 20 layers of tape and then it fizzled. Of course there were bugs, so many that the idea was abandoned. This is but one avenue of experiment, and there are undoubtedly others.

One thing is fairly certain . . . nobody is going to sit on their hands and you can bet that wheels are churning now, slowly to be sure, but in time all this activity is sure to result in cheaper tape and a stable market.

BRAHMS
SYMPHONY #1
Boston Symphony Orchestra conducted by Charles Munch. Victor GCS-42. Price $18.95.

Yes, I know, Anent the above discussion, this is a staggering price to pay for a stereophonic tape. Yet that is what the companies feel they must get at present. Is it worth it? That depends on how badly you want Brahms 1st symphony in stereo. From the musical and technical standpoints the recording is certainly splendid. This is a massive work which makes strong demands on a large orchestra. Heard monaurally, the work is of heroic proportion, with a granitic solidly to its orchestration. Heard in the glories of stereo, the piece becomes almost overpowering. For lover of the "big sound," here is orchestral weight that will certainly please. From the relentless opening tympani beats, the work builds tower on tower, creating a monumental musical edifice. With the huge orchestra spread across the end of your room, the full impact of stereo hits you.

Munch is not the best of conductors for this work . . . he interjects too many fussy mannerisms. But his tempi are fairly straightforward, he has a fine sense of balance and proportion, and all-in-all his reading is acceptable. The recording was miked fairly close, but the magnificent Boston Symphony Hall acoustics allowed for this high detail by clothing it in spacious reverb. This is a very full sound, with good directionality and good center fill. The illusion of depth was very strong and instrumental delineation exceptional. My only quibble with this, is as odd one for stereo . . . the first strings were a mite on the strident side. As you know, one of stereo's most charming aspects is its ability to smooth out string tone. Most of the stridency occurs in the first few minutes, so it is not too objectionable. In summation . . . if you like Brahms, you will find this a terrific experience.

BACH, J. S.
PRELUDE AND FUGUE IN A MINOR
PRELUDE AND FUGUE IN E MINOR
TRIO SONATA #4
"WACHET AUF, RUFT UNS DIE STIMME"
Carl Weinrich at the organ of Varfrykyrka at Skanninge, Sweden. Sonotape SWB8025. Price $12.95.

This is another tape in the magnificent series *Sonotape* is devoting the organ music of J. S. Bach. This is one of the finest yet produced and the opening "Prelude and Fugue in A Minor" is breathtaking in its sonic

realism. The directionality was exceptional for an organ and the intricate pedal work, which is a feature of this work, is easily "seen" and heard to the left.

The other works are equally well recorded and well-played. Weinrich is simply fabulous in this recording, easily doing the best work of the series so far. As always, his phrasing and tempi geared to the acoustics of the church is a marvel and his choice of registration ever tasteful. This is very bright sound, rich in detail yet lovely in the rounded fullness of the wonderful acoustics. Solo pipes and mixtures were reproduced with equal clarity. The sense of depth here was startling . . . and added to the general impression of on-the-spot "presence."

OFFENBACH

TALES OF HOFFMAN (EXCERPTS)
ORPHEUS IN HADES OVERTURE
Boston Pops conducted by Arthur Fiedler. Victor ACS-49. Price $6.95.

This is one of the most sensational stereo tapes yet produced by *Victor!* I know, you are wondering what could be so hot about this kind of repertoire. Don't let this stereo fool you, friends . . . it can make a seemingly innocuous piece of music into a highly exciting work. This has all the stereo virtues in spades. Directionality? In the famous "Barcarolle" you will hear the most intriguing interplay between first and second strings and the celli. Depth? Really amazing on this score. Boston Hall acoustics taking a bow again. Instrumental separation? Every instrument is limned and yet is a cohesive part of the orchestra.

Fiedler does a perfect job of conducting these light confections and the Boston men play with wondrous precision and elan. There was excellent center fill on this tape, wide dynamics, good signal-to-noise-ratio. The over-all presence has to be heard to be believed. If you want to impress some friends with the quieter virtues of stereo, just play this "Barcarolle" for them and watch them melt!

500 MILES TO GLORY
The Indianapolis 1957 500-mile race. Mercury MS2-6. Price $8.95.

How is this for something different? This was actually recorded at the Indianapolis Speedway employing four stereo recorders and 12 microphones. There is a running commentary on the race itself, but need I say that the cars are the stars. It is also needless to say I'm sure, that directionality in stereo being what it is, you will have race cars zooming through your room. The first time you hear the whine and roar of the big Offenhausers is quite a thrill, but unhappily since all the cars in the race are of the same breed and there is no up and downshifting as with sports cars, the sound soon palls.

Worth the price of the tape, however, are the fantastic sounds of several crashes. This may be is carrying stereo realism a little too far! It's a

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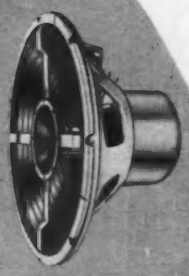

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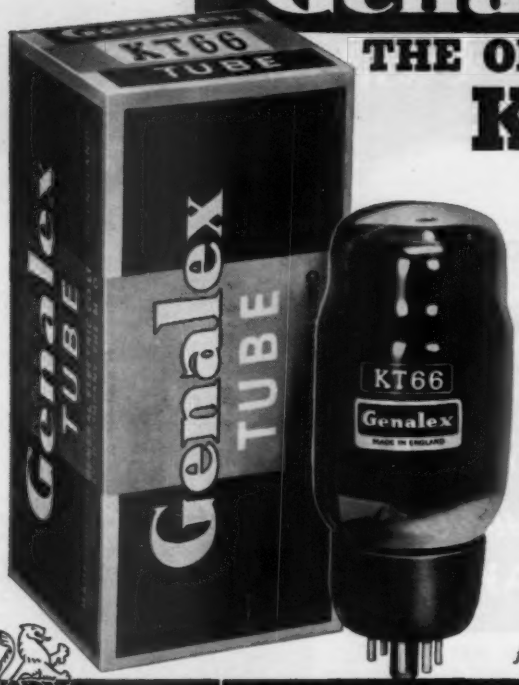

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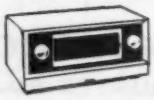

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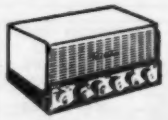

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terrifying sound on a big speaker system, as well it should since these boys are traveling at 130 to 180 miles an hour! The writer confesses freely that he is a wild-eyed sport car fanatic and after an apprenticeship in everything up to a Jag, is now tooling a "loaded" fuel injection Corvette. If plans work out, I'll be taking my *Ampex* stereo recorder to the Sebring Grand Prix in Florida. If I'm lucky, I may get a tape that will really show the sports-car side of the racing picture. Brother, you ain't heard nuthin' 'til you hear Fangio and Moss downshifting for the slow corner after the long straight!

CLUB STEREO

Mack Sheppard and his Orchestra. Stereophony, Inc. B126. Price $11.95.

Here is a tape for which you might not think there was much of a market, but actually there is considerable demand for this sort of thing. This is quite simply . . . good dance music. Dance music of the type you find in night clubs and country clubs everywhere. Sheppard leads his excellent group in a typical dance program with staples like, "When Your Lover Has Gone," "Dearly Beloved," "Stella by Starlight," etc. The engineers wisely chose to make this as acoustically "dead" recording as they could, with the result that in the home with average reverb characteristics, the feeling of presence is terrific. The very close-up recording afforded superb detail and every instrument can easily be aurally positioned. Directionality is excellent, not spread too wide in deference to moderate sized living rooms, and *Stereophony Inc,* which boasts of its good center fill, accomplishes that very neatly. The sound is very crisp, clean and bright, recorded at a high level and with very wide frequency range and good dynamics. Surface noise was as low as I've yet to hear on a commercial tape. If it's stereo dance music you want, you can't go wrong with this tape.

JAZZ AT STEREOVILLE

Cootie Williams, trumpet; Rex Stewart, cornet; Bud Freeman and Coleman Hawkins, tenor saxes; Lawrence Brown and J. C. Higgenbottom, trombones. Concert Hall EX40. Price $11.95.

Jazz has been fairly well served on stereo tape, but never with the success this tape affords. This is, without a doubt, the most exciting and effective jazz stereophonic tape I have heard. The fidelity of the recording and the high degree of musicianship make this one of the memorable experiences in many years of jazz listening.

A glance at the personnel involved and it's not hard to understand why this tape is so outstanding. These musicians are among the all-time greats on their respective instruments.

This recording makes use of an old and familiar device. Remember the "battles of music" and "battles of band" of the late thirties? A soloist or group of players would be pitted against a similar set-up, either in the same orchestra or in a rival orchestra.

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In various improvisatory rides and riffs, each group would try to outdo the other. The same idea is worked here. With the directionality afforded by stereo there is no doubt as to *where* the various players are located.

On the left channel we have Rex, Bud, and J. C. and on the right channel Cootie, The Hawk, and Larry. A solid rhythm section made up of Billy Bauer on guitar, Hank Jones on piano, Milt Hinton on bass, and Gus Johnson on the skins provides a solid beat for the boys on the horns. The tremendous drive of this group and their very expressive individualism in ride passages has to be heard to be believed.

The first number on the tape is "I'm Beginning to See the Light" and in their unrestrained free-swinging style both sides have a go at each other. In the famous old "Do Nothing 'Til You Hear From Me," this is mostly the gutty, very "dirty" trumpet of Cootie on the right channel backed up by very nice ensemble work. The final number, "Alphonse and Gaston," gives the rhythm section a break to show their skills during the opening bars. Then, as the name implies, the battle of the players resumes. All do great work, but I was most impressed by the trombone duel between Higgenbottom and Brown which occurs just after the rhythm introduction.

Soundwise this is fabulous. The directionality has probably been a little exaggerated, but there is no doubt as to its effectiveness. Each player is highlighted as to position, yet there is no overpowering sense of left and right, when the rhythm section fills in. The recording was made very close-up and employed a fairly spacious acoustic perspective. The result is great instrumental detail, wherein you can hear the sharp brazenness of the trumpet and cornet, the breathy reediness of the saxes, and the growls and gutturals of the trombones and yet the acoustic treatment wraps everything in an impressive liveness.

I can most certainly recommend this tape to anyone interested in hearing what solid, honest jazz sounds like in the stereo medium. For jazz buffs this tape is an absolute *must!*

LOCO-MOTION
Joe Loco and his Latin American Rhythms. Mercury MBS-210. Price $10.95.

This could conceivably be used as dance music, but the dancers would sure have to be light on their feet and most athletic! Joe Loco ees crazy name senor, an he mek crazy music! All kidding aside this is a fabulous recording and is just about the best Latin-American stereo I have heard. The tunes are all indigenous to the warm and lazy Caribee.

Directionality here is nigh perfect even if contrived and center fill is there aplenty. A very bright and high level recording, this time with judicious reverb lending life to the highly detailed sound. The frequency and dynamic range was most impressive and tape hiss was not obtrusive. —30—

THE VIKING BILLBOARD

Vol. 1 *No. 1*

The current Hi-Fi Annual (Ziff-Davis) contains reprints of *A Tape System You Can Build*, originally published in RTN. This has resulted in a new flood of inquiries to Viking regarding the special power transformer, erase-bias oscillator transformer and other components peculiar to the Viking RP61 Recording Amplifier described in those articles.

The original RP61 circuit has been constantly improved during the two years since initial publication. Circuit refinements include increased signal-to-noise ratio, elimination of need for a DC filament supply, a hum cancellation control, a circuit change to reduce head magnetization, improved tube types, a bias oscillator balance adjustment and means for synchronizing the erase-bias oscillators of two or more RP61's.

Decks, too, have undergone some change. Interim developments have made possible the double gap erase head now used by Viking. This makes possible clean, dead quiet erase, even at the very high erase-bias frequencies which Viking employs. (A high bias frequency is absolutely essential for clean recording of high frequencies.) Double winding (hum bucking) record/playback heads add at least 6db to the original signal-to-noise ratio, even in physically "tight" installations. The present overall signal-to-noise ratio of 55db places Viking components second only to the finest of professional recorders.

One of the major deterrents to progress of stereo has been the physical size of the required speakers. One six to twelve cubic foot box is perhaps acceptable in the average living room. The second is usually endurable only as a necessity to good stereo sound. There is also the problem that point sources provide for more realistic stereo sound.

It is with considerable confidence and satisfaction that Viking is currently announcing a completely new concept in loudspeaker enclosure design — the "Viking 88". This new speaker is end table size, utilizes an 8-inch driver and provides full-throated, balanced response from 30 to 12,000 cycles. It is a high efficiency speaker. It will handle unbelievable power levels without distortion.

A speaker system, admittedly, must be purchased on the basis of purely personal preferences as to styling, impressiveness and the apparent flatness, or accentuated areas of response. Viking dealers are now receiving their first samples of this new and style-setting speaker. See it, and hear it at your Viking dealer's. Judge it for yourself. A free "88" brochure is available from Viking's Customer Service Department.

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Which Way to Hi-Fi?

(*Continued from page 46*)

Another development on which some research has been done and we expect to see new products appear within the next year or so, will help the problem of amplifier-to-loudspeaker matching discussed earlier. This will take the form of switching in the amplifier circuit.

Careful experimentation has shown that different phase compensating arrangements, as well as varied combinations of feedback to achieve different damping factors, will produce the best over-all performance into *different types* of loudspeaker loads; for example dynamic type loudspeakers which with their crossovers, require varying damping factors to get the best performance; also a dynamic woofer with an integrated wide-range electrostatic.

A few components, skillfully chosen, with a selector switch, to choose the best combination for any individual speaker connection, should make a high-quality amplifier perform almost as well into a loudspeaker as it does into that "dummy" resistance load.

Package vs Components

Going back to this question, the foregoing discussion suggests that the future may offer a three-way rather than a two-way choice. A new approach, using what may be called "integrated component systems" is being used by a few manufacturers.

It is well known that the loudspeaker unit should be integrated with the enclosure design. In this case the do-it-yourself hobbyist can buy the wood or a kit, and make the enclosure to the loudspeaker manufacturer's specification for the units used. Several loudspeaker manufacturers have made these facilities available.

High-fidelity at present has reached a very high order. Undoubtedly further improvements will be made—many of them. But the present quality is certainly one with which it is possible to be satisfied for some time to come. This makes the choice of approach to high-fidelity depend on what you want of high-fidelity.

The package manufacturer *can* put together components designed to work together, without having to allow for the complicating problems discussed; he can provide a suitable cabinet for housing the system; and he can also cut costs because the whole system is built in an integrated production schedule. What is more, the package manufacturers certainly do not lack top-notch audio engineering talent. But most of the "high-fidelity" sold by a good many package manufacturers does not qualify for the name at all. This is particularly true of a great number of the less expensive units that are available.

Recently a friend called me up and announced "I now have 'a high-fidelity.'" When asked what and how much, the reply to the second part was "$59.50, complete—everything!" The next question from the other end of the line was, "Why do you laugh?" Anyone with a basic knowledge of what goes into a high-fidelity system knows that the raw materials for a quality system must cost more than $59.50. So no amount of cost cutting can produce a system for such a price. The quality must, of necessity, be drastically cut too.

This really is the big snag about the package market. Basically these manufacturers cater for the biggest possible sale at the lowest possible price, on the fact that anyone without real listening experience will never know the difference. After all "they can *hear* the music—what does it matter to them if it's distorted?" "Improvements" all too often consist of using three 5" loudspeaker units instead of a single 8" one, and calling it a "three-way speaker system." This makes it sound like a bargain at any price, because people in the know say that a three-way speaker system alone costs more than $59.50—as indeed a good one does!

Unfortunately, the package manufacturer, by the very market he serves, is practically forced into making a good "show" for the money, using tricks like this, rather than building real quality into his system. There are exceptions, but it takes real shopping to find them.

(Editor's Note: There are a few component manufacturers who have grouped together a number of their own units along with units made by other component manufacturers into a complete "packaged system" in its own cabinet. With this arrangement the quality of the system is determined by the quality of the individual components used and this may be quite high. However this system suffers from the same lack of flexibility of any packaged system.)

Using either a component system or an integrated component system—or a combination of both—you can get yourself the best system you can afford right now and also keep up with the development of better things as they become available. The simple component system has the advantage of highest versatility of combination, but you need to exercise care in making combinations, to avoid undesirable interaction.

The integrated component approach helps avoid inconsistency problems and, in some sections, may provide the best solution but you lose the advantage of versatility for trying certain variations in arrangement.

Whichever approach suits you best, don't fear your system is going to be out-dated overnight—or even in a year or two. The better high-fidelity gets, the less room it has to improve. So get yourself the best system you can afford and look forward to progressing, along with your system, toward better standards, as they become available. —30—

Dr. Volney C. Wilson inspects one of his experimental thermionic converters.

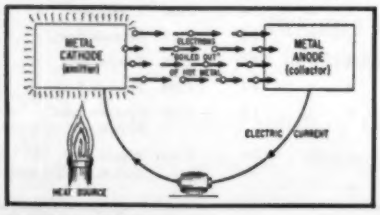
New Converter Changes Heat to Electricity

Direct conversion of energy achieved in experimental unit.

DIRECT conversion of heat energy into electrical energy has been achieved in a unique electronic device developed at the *General Electric Research Laboratory*. The new thermionic converter, invented by Dr. Volney C. Wilson, takes advantage of the simple fact that electrons can be "boiled out" of a hot metal surface and used to produce an electric current directly. Experimental converters already have changed more than 8 percent of the applied heat energy into electric power, producing a power output of almost 1 watt at a voltage of 0.8 v.

Two electrodes within the tube-like device are maintained at high, but different, temperatures. New approaches to the design of the electrodes, the materials used, and the gas environment within the envelope have resulted in a more efficient flow of electrons than ever noted before. Previous methods of converting heat directly into electricity have been based on the thermocouple, with efficiencies well below 1 per-cent. Thermionic converters ultimately may be able to work at 30 per-cent efficiencies. —30—

Operation of converter is somewhat like a rectifier tube without plate voltage.



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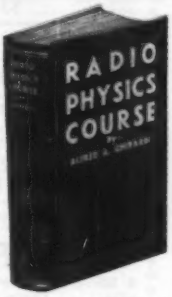

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25 M.d	600 VDC	3.40	8 Mfd	2500 VDC	5.25
20 Mfd	650 VDC	2.75	6 Mfd	2500 VDC	5.75
1 Mfd	1000 VDC	.60	10 Mfd	2500 VDC	6.25
2 M.d	1000 VDC	.75	1 Mfd	3000 VDC	1.85
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10 Mfd	1000 VDC	1.75	8 Mfd	3000 VDC	8.75
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2BN4	2.0	76	24	J	R	2	5	0	3	0	P4	1950	
3BN4	3.0	76	24	J	R	2	5	0	3	0	P4	1950	
4AL5	4.3	78	0	J	R	0	7	0	3	0	P1	....	Diode No. 1
4AL5	4.3	78	0	J	R	0	2	0	5	0	P1	....	Diode No. 2
4AU6	4.3	76	11	J	R	3	5	6	7	2	P4	1840	
4BA6	4.3	79	0	J	R	3	5	6	7	2	P4	2160	
4BE6	4.3	35	0	J	R	7	5	6	2	3	P1 with P4	640	Ampl. Sect.
4BE6	4.3	90	20	J	R	3	6	0	2	7	P4	5200	Osc. Sect.
4BZ6	4.3	82	5	J	R	3	5	6	2	7	P4	3000	
5BC8	5.0	81	24	E	V	7	6	0	8	0	P4	2300	Triode No. 1
5BC8	5.0	81	24	E	V	2	1	0	3	0	P4	2300	Triode No. 2
5BQ7*	5.0	88	20	E	V	7	6	0	8	0	P4	4000	Triode No. 1
5BQ7*	5.0	88	20	E	V	2	1	0	3	0	P4	4000	Triode No. 2
5BS8	5.0	88	20	E	V	7	6	0	8	0	P4	4000	Triode No. 1
5BS8	5.0	88	20	E	V	2	1	0	3	0	P4	4000	Triode No. 2
5BZ7*	5.0	88	20	E	V	7	6	0	8	9	P4	4000	Triode No. 1
5BZ7*	5.0	88	20	E	V	2	1	0	3	9	P4	4000	Triode No. 2
5CG8	5.0	86	17	E	V	1	2	0	3	0	P4	3100	Triode Sect.
5CG8	5.0	81	13	E	V	9	6	7	8	0	P4	2400	Pentode Sect.
5CL8	5.0	83	25	E	V	1	2	0	3	0	P4	2125	Triode Sect.
5CL8	5.0	74	17	E	V	9	6	7	8	0	P4	1700	Tetrode Sect.
5CM6	5.0	70	35	E	V	3	9	1	7	0	P4	1550	
5CM8	5.0	33	18	E	V	9	1	0	8	0	P4	600	Triode Sect.
5CM8	5.0	81	13	E	V	2	6	7	3	3	P4	2400	Tetrode Sect.
6BA6	6.3	79	0	J	R	3	5	6	7	2	P4	2160	
6BJ7	6.3	82	0	E	V	0	8	0	9	0	P1	....	Diode No. 1
6BJ7	6.3	82	0	E	V	0	6	0	7	0	P1	....	Diode No. 2
6BJ7	6.3	82	0	E	V	0	2	0	1	0	P1	....	Diode No. 3
6BN4	6.3	76	24	J	R	2	5	0	3	0	P4	1950	
6BZ8/ X155*	6.3	88	18	E	V	7	6	0	8	9	P4	3000	Triode No. 1
6BZ8/ X155*	6.3	88	18	E	V	2	1	0	3	9	P4	3000	Tr ode No. 2
6CM8	6.3	33	18	E	V	9	1	0	8	0	P4	600	Triode Sect.
6CM8	6.3	81	13	E	V	2	6	7	3	0	P4	2400	Tetrode Sect.
6CZ5	6.3	81	31	E	V	3	9	1	7	0	P4	2400	
6DA4	6.3	50	0	J	X	0	5	0	3	0	P3	....	
6DA7	6.3	78	23	E	V	7	6	0	8	0	P4	2150	Triode No. 1
6DA7	6.3	87	53	E	V	3	1	0	9	0	P4	3300	Triode No. 2
6DE7	6.3	70	30	E	V	7	6	0	8	0	P4	1500	Triode No. 1
6DE7	6.3	83	61	E	V	2	1	0	9	0	P4	3000	Triode No. 2
8AW8	10.0	87	0	E	V	2	3	0	1	0	P4	2900	Triode Sect.
8AW8	10.0	85	19	E	V	7	9	8	6	0	P4	2725	Pentode Sect.
9CL8	10.0	83	25	E	V	1	2	0	3	0	P4	2125	Triode Sect.
9CL8	10.0	74	17	E	V	9	6	7	8	0	P4	1700	Tetrode Sect.
9X8	10.0	80	16	E	V	7	9	8	6	1	P4	2300	Pentode Sect. Switch on Life Test
9X8	10.0	72	25	E	V	2	3	0	6	0	P4	1500	Triode Sect. Switch on Life Test

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"Muscle Mouse"
(*Continued from page* 55)

as this is another high current spot.

The antenna windings shown in the parts list are for a typical 52-ohm or 72-ohm-fed antenna feeder. Other feeder lines (for example, 300 ohms) may require some modification.

The transmitter is tuned up like any other transmitter—but perhaps a few words will be of help to the newcomer. First, connect a 25-watt light bulb to a phono input plug and plug it into the antenna output receptacle. Press the key and rotate the tuning capacitor. If all is well, the neon bulb will light at some setting of the capacitor.

Note that in rotating the tuning capacitor, at one point the dial light current indicator indicates a very sharp dip. At *approximately* the same point, the neon bulb glows most brightly. The point for proper tune-up is that point at which the neon bulb is the *brightest* and the dial light is the *dimmest*.

Tuning up to an antenna is similar; "load" up by sliding the antenna coil down on the plate coil, until the dial light barely dips. Again, select the point at which the dial light indicates the minimum current and the neon bulb is the *brightest*. —30—

A PHONO PLUG HANDLE

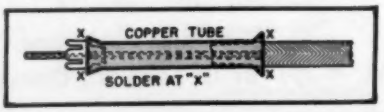
By M. JOHN WAGNER

THE almost standard adoption of phono pin-plugs and jacks as the method of hooking up audio components creates problems for the assemblers of such equipment. Although they are conveniently small and make good connections, these pin-plugs are difficult to withdraw from a tight-fitting receptacle unless one simply jerks on the wire. After a few jerks, the shielded lead is likely to break away from the pin-plug because the connection at this point is usually weak. This particular solder joint is an unusually awkward one to make in the first place, and it rarely looks as neat as one would like.

Here is a way to overcome the problem. When attaching leads to these pin-plugs, prepare the wire to be inserted into the plug in the usual way, but instead of drawing it through the side of the shielding, simply remove the shielding from the last inch or so of the lead. Then cut a piece of one-quarter inch copper tubing, about one or two inches long. Flare both ends of the piece of tubing and slide the shielded lead completely through it. Solder the wire into the pin-plug as usual; then slide the tubing down the wire, firmly against the end of the pin-plug shield, and solder it there. Finally, solder the shielding to the opposite end of the tube.

The process makes a neat, strong connection and provides a convenient handle by which to grasp the plug when removing it from a tight receptacle. —30—

"Handle" facilitates phono plug removal.



An "Automatic Rheostat"

(*Continued from page 42*)

The graphs of Figs. 4 and 5 show the effect of the stepped delays with a receiver rated at 205 watts. The broken line in Fig. 4 shows current measured to the set during warm-up time before the protective device was installed. The solid line traces current after installation up to the time of stabilization. Note that final current with the automatic device is slightly greater than without it. This is accounted for by the small amount of current consumed by the delay tubes.

The broken line in the graph of Fig. 5 shows voltage available from the rectified and filtered power supply before the device was installed. The stepped increase measured after installation is shown by the solid line. At no time are the filter capacitors' working-voltage ratings exceeded.

Although the graphs are shown for a set rated at 205 watts, most recent sets are sufficiently close in power consumption so that the device, with the resistor values shown, would provide essentially the same protection. However, the values of the dropping resistors could be adjusted, if desired, to provide the same warm-up pattern for lesser or greater receiver loads.

Since the three most common troubles with electronic equipment are the failure of rectifiers, of other tubes, and of electrolytic capacitors, the automatic rheostat is a valuable addition to any set. The longer life of these parts will more than pay for the expense of the device. —30—

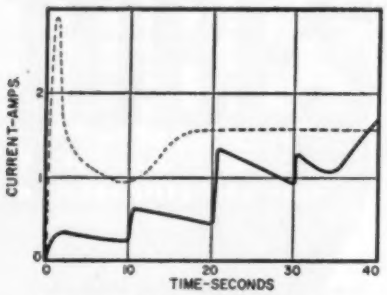
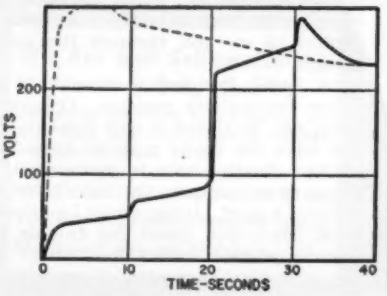


Fig. 4. Input a.c. current to receiver before (broken line) and after (solid line) the delay device was installed.

Fig. 5. Broken line traces normal "B+" output of the receiver. Solid curve is the same output after delay is provided.



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IF YOU are a member or officer of a service association, you will certainly be interested in this month's editorial on page 8. In fact, if you are a non-member who has ever thought of joining such a group, provided that one came along that suited you, you will still want to read the editorial. Perhaps you can help answer our question.

Texas Magazine

The recent release of the first issue of the "T.E.A. Times" as the official magazine for the Texas Electronic Association represented the third publication to be started by major service associations during recent months. The "T.E.A. Times" will be a quarterly magazine devoted to state, national, and local association news of interest to service dealers in Texas.

In launching the new publication Leonard R. Smith, its editor, said: "The officers of the Texas Electronic Association felt that a regular means of communication was necessary in order to keep the individual members of T.E.A. affiliates informed on statewide developments in the service industry. 'T.E.A. Times' will be sent to every established service dealer in the State of Texas. It will keep them informed on what T.E.A. is doing to raise the level of TV and related electronic servicing and to improve the business climate of the entire service industry.

"In a far-flung organization like the Texas Electronic Association, it is impossible for the officers to keep members informed about the progress of association programs through personal contact alone. This quarterly magazine will help us to weld our association into the kind of a cooperating force we need to establish stability in the electronic service field."

Mr. Smith was the chairman of the highly successful Annual Clinic and Fair held in Fort Worth last August. Copies of the "T.E.A. Times" may be obtained from Leonard R. Smith, editor, 1105 May Street, Fort Worth 4, Texas.

Penna. House Organ

The Electronic Service Dealers Association of Western Pennsylvania published the first issue of its official house organ during the late fall. Named the "ESDA Scanner," one thousand copies of the initial issue were printed for distribution to service dealers in Pennsylvania and adjoining states.

Edited by B. A. Bregenzer, who is also chairman of the Federation of Television-Radio Service Associations of Pennsylvania, the initial issue of the "Scanner" marked the first anniversary of the Pittsburgh Service Dealers Association. The organization, initially formed by eleven men, has grown rapidly during its first year of existence. Under the leadership of Joseph S. Doyle, its president, membership has grown to include over 100 shops.

In his talk at the annual banquet, Mr. Doyle said: "We believe we have proven to the public that all television service men and dealers are not thieves. We have corrected many evils. We will correct many, many more. Standards have been set up. Those who desire to remain in the service business will, in time, be required to meet them. We will, at all times, strive to improve on our present standards. In the very near future the well-known axiom, 'By your actions you shall be known,' will prevail in this industry."

Information about the "ESDA Scanner" may be obtained from B. A. Bregenzer, 1741 East Street, Pittsburgh 12, Pa.

Indiana Publication

The "Hoosier Test Probe" is the third publication launched by a major service association in recent months. Edited jointly by Frank J. Teskey and Robert M. Sickels, the "Test Probe" is the publication of the Indianapolis Television Technicians Association.

In a recent issue, Editor Sickels presented some sage advice to readers under the caption, "You and Your Business." He said:

"Do you really run your business? Have you got a firm hand on the rudder? Or are you drifting aimlessly from day to day?

"A well regulated business budgets its money. Promotions are planned far in advance, so as to get the most consistent effect from advertising. Two to three per-cent of your annual gross revenue plowed back into advertising will maintain your present volume against the normal loss of customers. A 5% advertising budget, well spent, will build business.

"Do you allow distributor salesmen to load you with too much merchandise? A well managed business buys only its requirements and leaves the warehousing to the supplier.

"Do you take all of your trade discounts? Now that the busy fall season is upon us, money will flow into your cash register much more easily. *NOW* is the time to get on a cash basis. *NOW* is the time to lay up some extra capital to see you through the slow months ahead.

"A liquid business is always in a better competitive position. Opportunities can be seized in soft markets, if you have the ready cash on hand.

"And finally, how is your credit? It's a rare business that can operate without a good, strong credit line these days. Have you taken the trouble to identify yourself with a good bank? If you ever plan expansion of your busi-

ness, start looking to your credit line now. Too many operators have found a much needed expansion program impossible because of past credit mistakes."

Copies of the "Hoosier Test Probe" may be obtained from either Frank J. Teskey, 2912 Clifton Street, Indianapolis, Ind., or Robert M. Sickels, 1859 South East Street, Indianapolis.

New Association

A group of service dealers and technicians met recently to form a service association in Terre Haute, Indiana. Organizers of the new group included W. C. Anderson of *Ace Electronics;* T. Bourbeax of *Commercial Radio & TV Service;* C. Carrithers of *Jensen TV & Appliances;* Robert Easton of *Midwest Radio & Appliances,* and E. C. Oberholtzer of *Obie's TV.*

Mr. Anderson was elected temporary chairman of the organization and Mr. Eourbeax was named temporary secretary. Information about the organization may be obtained by contacting W. C. Anderson, *Ace Electronics,* 1001 College Ave., Terre Haute, Indiana.

Tennessee Plaint

T. R. Nabors, president of the Middle Tennessee Technicians Association, took service dealers to task for their indolence in a recent issue of "MTTA News." Under the caption, "We Asked For It," Mr. Nabors said:

"One of our many great opportunities has passed us by, without the slightest recognition by most of us, because we have been lulled to sleep by our false sense of security and self-esteem.

"When television was first introduced in Nashville and middle Tennessee, we were all very enthusiastic about the opportunities in the field of TV servicing. Realizing that only trained technicians could render this valuable service, we applied for and received special training in this phase of electronics.

"Today, however, electricians, plumbers, carpenters, truck drivers, firemen, refrigeration mechanics, and many others have decided TV servicing is a good field to explore because anybody can learn to change a few tubes. If one tube doesn't cure the trouble, keep changing them until some combination does. We in the service industry know how disastrous the results have been to the general public from these 'tube changers.' It has brought us unjust and unwarranted criticism. All of the glamor and prestige of being an expert technician in the electronic field has been trampled in the mud.

"When are we, the licensed shop owners and technicians, going to stop bickering among ourselves and start fighting for what is ours? When are we going to play fair with the public and ourselves and start defending our customers and ourselves against the unethical and unlicensed Fast-Buck Boys and Quacks?"

—30—

MYSTERY PACKAGE

20 Pounds of ELECTRONIC PARTS
Worth $40.00
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$3.95
It's Another THRILLING HERSHEL SURPRISE. 20 pounds of BRAND NEW usable Govt. Surplus. Perfect gift for Home, etc.

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B-29 BOMBSIGHT
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Below Is A Partial List—Send For FREE Complete List and Order Form

0Z4	.42	5AT8	.79	6BK7	.75	7A4	.46	12J5	.39
1A7GT	.42	5J6	.79	6BL7GT	.74	7A5	.52	12L6	.59
1B3GT	.66	5T8	.79	6BN6	.57	7A6	.44	12SA7	.47
1C5GT	.40	5U4G	.48	6BQ5GT	.57	7A7	.44	12SQ7	.54
1C6	.25	5U8	.79	6BQ7	.75	7A8	.44	12SJ7	.44
1C7G	.25	5V4G	.57	6BY5G	.57	7AU7	.69	12SK7	.47
1D5GP	.42	5V6GT	.49	6BZ7	.75	7B4	.43	12SL7GT	.59
1N4G	.45	5X8	.79	6C4	.36	7B5	.40	12SN7GT	.59
1J6GT	.46	5Y3	.38	6C8G	.50	7B6	.41	12SQ7	.39
1L4	.45	5Y4G	.42	6CD6G	1.17	7B7	.42	12V6GT	.44
1L5	.54	6AL3	.44	6CU5	.79	7B8	.40	12W6	.59
1LA4	.55	6A7	.56	6D6	.47	7C4	.40	12X4	.36
1LA6	.48	6A8	.44	6E5	.43	7C5	.41	14A7	.44
1LB4	.58	6AB4	.44	6F5	.36	7C6	.42	14B8	.44
1LC5	.48	6AC7	.66	6F6	.37	7C7	.44	14Q7	.44
1LC6	.46	6AF4	.75	6H6	.37	7E5	.44	19T8	.69
1LD5	.56	6AG5	.69	6J4	1.50	7E6	.44	19BG6G	1.17
1LE3	.56	6AG7	.68	6J5	.38	7E7	.48	25BQ6GT	.84
1LH4	.63	6AH4G2	.69	6J6	.48	7F7	.58	25CA5	.79
1LN5	.48	6AH6	.70	6K6GT	.38	7F8	.58	25CD6	1.29
1N5GT	.48	6AK5	.55	6N7	.74	7G7	.74	25CU6	.99
1R5	.50	6AL5	.41	6L6	.67	7M7	.57	25L6GT	.46
1S5	.45	6AM8	.79	6N7	.59	7Q7	.58	25W4GT	.42
1T4	.45	6AN8	.79	6P7	.50	7S7	.54	25Z6	.36
1U4	.46	6AQ5	.45	6S4	.39	7Y4	.34	27	.24
1U5	.45	6AS5	.47	6S8GT	.70	7Z4	.39	35B5	.47
1V2	.70	6AS7G	2.25	6SA7	.47	12A4	.59	35C5	.47
1X2	.66	6AT6	.38	6S8TY	.75	12A6	.40	35L6GT	.46
2A3	.49	6AT8	.79	6SC7	.47	12AQ5	.59	35W4	.38
2A7	.54	6AU4GT	.60	6SG7	.40	12AU6	.40	35Y4	.38
2D21	.95	6AU5GT	.60	6SH7	.42	12AT6	.40	35Z3	.40
3A4	.50	6AU6	.42	6SJ7	.42	12AT7	.65	35Z5GT	.38
3A5	.50	6AU8	.79	6SK7	.49	12AU6	.41	39/44	.25
3AL5	.52	6AV5GT	.64	6SL7GT	.66	12AU7	.58	50A5	.47
3AV6	.52	6AV6	.38	6SN7GT	.56	12AV6	.41	50B5	.47
3BZ6	.57	6AW8	.89	6SQ7	.40	12AV7	.66	50C5	.47
3BC5	.57	6AX4GT	.65	6S7Y	.40	12AX4GT	.44	50L6GT	.44
3BN6	.57	6AX5GT	.56	6T4	.85	12AX7	.62	80	.39
3CB6	.57	6BA6	.46	6T8	.67	12AZ7	.62	84/6Z4	.45
3Q4	.55	6BC5	.49	6U5	.54	12B4	.67	117L7GT	1.25
3Q5GT	.56	6BC8	.89	6U8	.79	12BA6	.45	117N7GT	1.25
3S4	.46	6BD5GT	.52	6V3	.79	12BA7	.59	117P7GT	1.25
3V4	.55	6BE6	.45	6W6GT	.45	12BE6	.45	117Z3	.36
4BQ7	.75	6BF5	.39	6W4GT	.39	12BH7	.89		
4BZ7	.75	6BQ6G	1.17	6W6GT	.82	12BY7	.63		
5AM8	.79	6BH6	.50	6X4	.38	12CA5	.59		
5AN8	.79	6BJ6	.46	6X8	.74	12CU6	.79		
5A93	.49	6BK8	.67	12DQ6	.79		

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534	3,000	3.5	6	**79¢ ea.**
496	40,000	3.5	6	

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523	10,000	3.5	10	
494	12,000	0.89	10	

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Simple 3-Channel Mixer

(*Continued from page 51*)

The cathodes are heavily bypassed to prevent the generation of hum by a.c. break-through from the heaters. Next, the signals come to the 1-megohm interstage leveling controls. These allow for more efficient use of the mixer controls in addition to preventing unusually strong signals from overloading the second stage. It is at this stage, a 12AX7, that it is permissible to leave the cathodes unbypassed. The cathode resistors are small, raising the transconductance and permitting the use of a small amount of degeneration. This gives the 12AX7 a larger signal handling capacity in addition to lowering the distortion produced by this stage. After the 12AX7 the signals enter the mixing circuit.

The plates of the mixer tubes provide an ideal feed for a cathode follower, a good use for the remaining half 12AU7. The current amplifier is then coupled to the output jack by a .25 μfd. capacitor, large enough to work into a load of about 50,000 ohms or more. If the load is more than 100,000 ohms, .1 μfd. is enough.

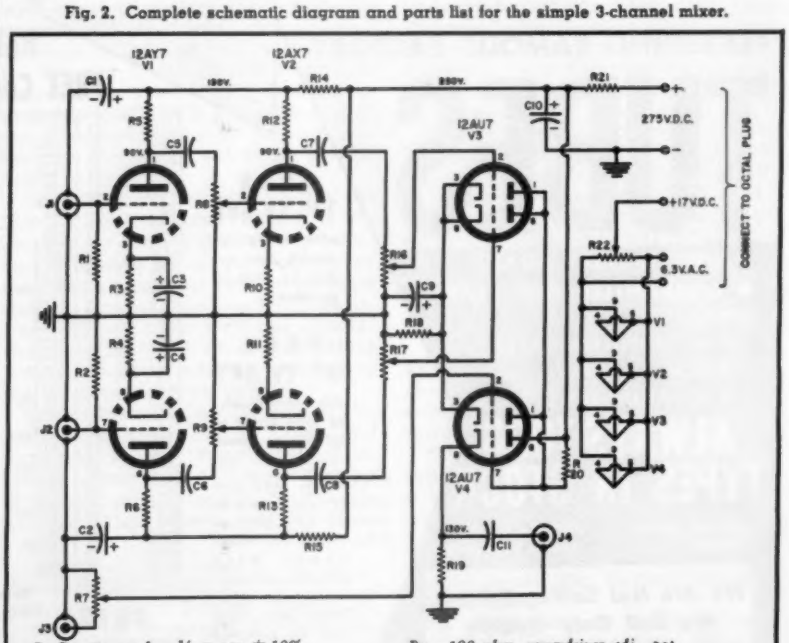
An external power supply providing 275 volts at 10 ma. and 6.3 volts a.c. at 1.2 amps is necessary. These potentials can usually be "stolen" from a power amplifier or other associated equipment without danger of instability of any sort. The heaters are balanced through a 100-ohm potentiometer to a positive d.c. potential of about 17 volts. This voltage was taken from the power supply by installing two extra resistors in its chassis. The capacitors used for filtering were 2 triple electrolytics. Separate ground buses are used for each input to prevent ground loops. "B—" is connected directly to the buses, which are connected to the chassis only at the input jacks.

Transformers were not used in the author's mixer, but the builder can install them on the chassis if they are not too close to the power supply or other a.c. fields. If this is done, a larger chassis than the 5" x 2" x 7" model used by the author is necessary. Two ⅝"-27 microphone connectors were used in the author's mixer, but the builder can use any type that will match those on his mikes. The same holds true for the *RCA*-type high-level input and output jacks.

Some difficulty was encountered with a microphonic 12AX7; perhaps the premium 12AD7 would be a better choice. Four 100,000-ohm, 1-watt resistors were used in the plate circuits to minimize resistor noise; deposited carbon units might be more effective.

The mixer makes an interesting project and a very useful piece of equipment to have around the audio workshop. —30—

Fig. 2. Complete schematic diagram and parts list for the simple 3-channel mixer.



R_1, R_2—1 megohm, ½ w. res. ± 10%
R_3, R_4—2200 ohm, ½ w. res. ± 5%
R_5, R_6, R_{13}, R_{19}—100,000 ohm, 1 w. res. ± 5%
R_7, R_8, R_9, R_{15}, R_{17}—1 megohm pot (R_8, R_9 to be screwdriver-adjust type)
R_{10}, R_{11}—510 ohm, ½ w. res. ± 5%
R_{14}, R_{16}—39,000 ohm, 1 w. res. ± 10%
R_{18}—1500 ohm, ½ w. res. ± 5%
R_{20}—47,000 ohm, 2 w. res. ± 5%
R_{21}—33,000 ohm, 2 w. res. ± 5%
R_{22}—2700 ohm, ½ w. res.
R_{23}—100 ohm, screwdriver adj., pot
C_1-C_2-C_{10}—20/20/20 μfd., 450 v. elec. capacitor
C_3-C_4-C_{9}—40/40/40 μfd., 25 v. elec. capacitor
C_5, C_6, C_7, C_8—.01 μfd., 400 v. capacitor
C_{11}—.25 μfd., 400 v. capacitor (see text)
J_1, J_2—⅝"-27 microphone connector (see text)
J_3, J_4—RCA-type phono jack (see text)
V_1—12AY7 tube
V_2—12AX7 tube (12AD7 preferred, see text)
V_3, V_4—12AU7 tube

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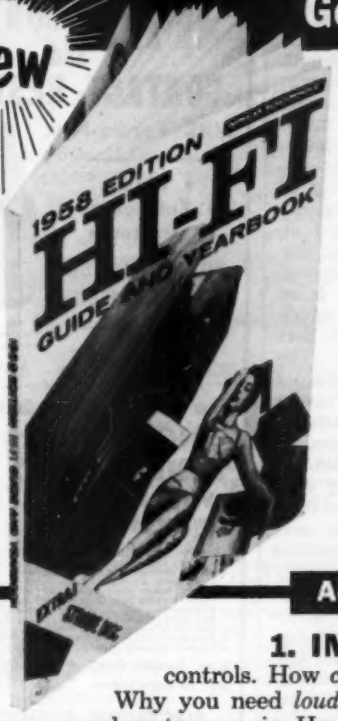

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15.01	16.7	17.15	18.225
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Radio Astronomy

(*Continued from page 38*)

moon. The problem cannot be appreciably eased by increasing the length of the transmitter pulse with appropriate decrease of receiver bandwidth, because of the Doppler spread introduced by the rotation of the planet. The rotation period of Venus is unknown (this would, in fact, be one of the main scientific results to be expected from the experiment), but on the basis of current estimates of the rotation period, the Doppler spread would probably limit the useful pulse width to about 40 milliseconds, which is only somewhat longer than that used in the lunar investigations. The main factor must therefore be achieved in the gain of the aerial, by increasing the transmitter power, and possibly by integration of successive echoes.

Attempt to Secure Planetary Echoes: This problem has been carefully considered at Jodrell Bank in relation to the very great gain of the new telescope, and an attempt to obtain planetary echoes will be made early in the research schedule. The complete return journey of the earth-Venus radio signal will take 4 minutes, and success in detecting such a radio echo would be a spectacular technical accomplishment. Nevertheless, the experiment could not be justified on this basis, and it is hoped that with the telescope a systematic program will be possible, in which the rotation period can be determined and information obtained about the Venusian surface and atmosphere.

A further interest in this planetary work is the possibility of measuring the range of the planet with sufficient accuracy to improve our knowledge of the solar parallax. The present position is that the two most accurate optical measurements should be correct to 1 part in 10,000 but differ between themselves by 1 part in 1000. The possibility of improving this measurement by the radio echo technique will certainly receive immediate attention if the initial attempts at detection are successful.

The foregoing constitute a few examples of the type of work on which the telescope is likely to be engaged during the next few years. Its field of activity is enormous and as opportunity allows it will be used to study the radio emissions from the sun and planets in addition to the galactic and extragalactic work already mentioned. On the transmitting side, in addition to the lunar and planetary work it will be deployed in the study of radio echoes from very faint meteors, from the aurora borealis, and from the earth satellites. The telescope enters on its research career at a moment of extreme interest, and it may well be expected to make a significant contribution to astronomy and various aspects of geophysics for many years to come. —30—

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RADIO-TV *Parts Puzzle*

By JOHN A. COMSTOCK

DO YOU pride yourself on your familiarity with radio and television components? If you do—here is a crossword puzzle for you to try to see if you can back up your professed familiarity with the various parts and devices used in electronic circuits with performance. Fill in all the blocks correctly and your "parts rating" is excellent. This will also indicate that you are better-than-average on theory as well!

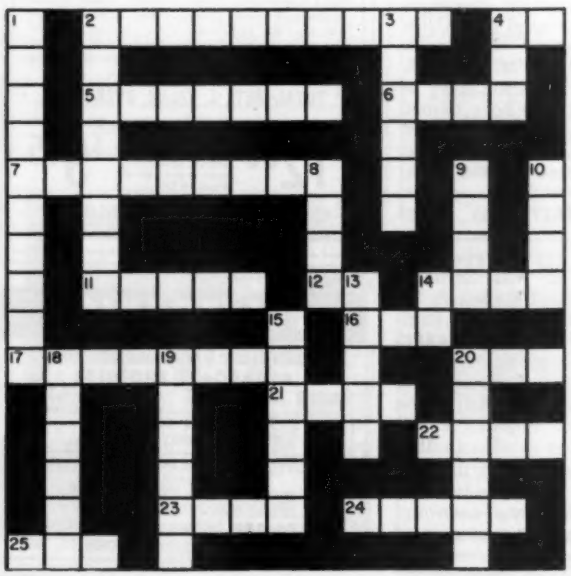
(*See page* 169 *for solution.*)

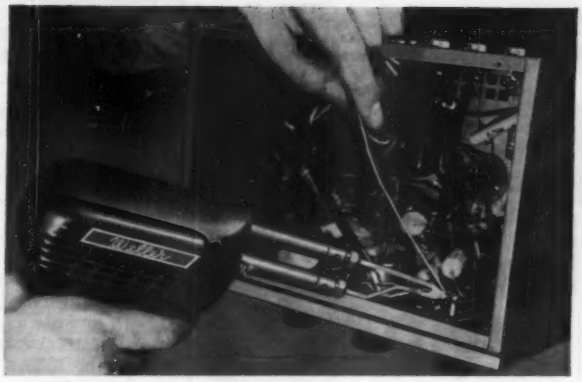
HORIZONTAL

2. A type of electron tube which contains little or no gas.
4. Letter symbol for the screen grid of an electron tube.
5. A chemically reacting device that stores electrical energy.
6. A circuit protector.
7. Tubing sometimes used to provide additional insulation for a wire.
11. Device used in one circuit to control another circuit.
12. Abbreviation meaning wires are not connected.
14. A gate-like structure in an electron tube.
16. When a transformer has loose laminations it often does this.
17. Resistor-type control used in a circuit to vary amount of current flow.
20. Some power transformers have a center ——— which is grounded.
21. Found around the neck of a cathode-ray tube in a television receiver.
22. Replaceable part of some cartridge-type fuses. Also a type of r.f. coupling.
23. Found in projection TV receivers and cameras.
24. A two-element electron tube.
25. Abbreviation for secondary winding of a transformer.

VERTICAL

1. Compact, unilateral device which is gradually replacing electron tubes in some circuits.
2. Used in a car radio to convert direct current to alternating or pulsating d.c.
3. Used in conjunction with a speaker or several speakers to improve reproduction.
4. Abbreviation for wire; meaning single-cotton-covered over enamel wire.
8. Metal used in the construction of transformer cores.
9. Abbreviation for speaker.
10. A connecting wire.
13. Usually used in conjunction with capacitors to form a filter.
14. Letter symbol for mutual conductance.
15. A record player or disc recorder needle.
18. A six-element electron tube.
19. Placed around a component to prevent stray coupling.
20. A three-element electron tube.





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2. **Practical Radio Servicing** — 509 pages. 473 illus. By William Marcus, Alex Levy, Electronic Training Experts.
3. **Profitable Radio Troubleshooting** — 330 pages. 153 "how-to" illus. By William Marcus, Alex Levy.
4. **Profitable TV Troubleshooting**—Short-cuts to spot and fix every trouble. By Eugene A. Anthony, Service Consultant, General Elec. Company.
5. **Repairing Record Changers** — 278 pages. 202 A-B-C pictures. By Eugene Ecklund, Eng. DuMont Lab., Inc.
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Within the Industry

(*Continued from page 32*)

J. Thompson Memorial Prize Award for his paper entitled "Backward-Wave Oscillator Experiments at 100 to 200 Kilomegacycles" which appeared in the April 1957 issue of "Proceedings of the IRE." The award is given annually to the author under thirty years of age whose article constitutes the best combination of technical contribution and presentation of the subject.

Both awards will be presented at the annual IRE banquet March 26, 1958 during the 1958 national convention of the Institute.

* * *

DR. J. R. MADIGAN has been promoted to the position of chief engineer by the *Hoffman Semiconductor Division, Hoffman Electronic Corporation* of Evanston, Ill.

He joined the firm about a year ago as a physicist in the research department. He will report to Donald C. Dickson, vice-president and director of engineering for the company and will be responsible for developing and controlling the pilot production of new electronic devices made from solid-state materials as well as product improvement on the firm's standard lines of semiconductors.

Dr. Madigan was director of the solid-state physics laboratories of the Illinois Institute of Technology, before accepting his present position.

* * *

CLARENCE F. JENSEN is the new chief engineer of *Jensen Industries, Inc.*, Forest Park, Ill. He was with *Webster Electric* for 14 years before assuming his new post . . . **ALBERT J. HARCHER** is the new production manager at *Clevite Transistor Products*. He was formerly associated with *CBS-Hytron* before accepting this newly created position . . . **JOHN M. MALONE**, electronic equipment sales manager of *Tung-Sol Electric Inc.* has been named assistant general manager of the firm . . . *Sylvania Electric Products Inc.* has named **HENRY McCONNELL** manager of its wire plant in Warren, Pa. . . . **EMIL L. deGRAEVE** has joined the corporate staff of *Litton Industries* to undertake new development planning activities. He was formerly connected with Stanford Research Institute where he held various engineering posts . . . **DONALD S. PARRIS** has been named director of the electronic division of the Business and Defense Services Administration of the U. S. Department of Commerce. He joined the government service in 1935 and since 1953 has been acting director of the division he now heads . . . **THOMAS P. CLEMENTS** has been appointed national service manager of *Admiral Corporation*. He has been as-

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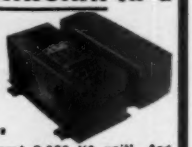
a TERRIFIC BARGAIN in a SOLA CONSTANT-VOLTAGE TRANSFORMER

Ends fluctuating line voltage!



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the factory price at a 1-input 2,000 VA unit! And here's another bonus! This Air Forces 2,000 VA overstock, Sola Cat. No. 30768, has 4 inputs! 90-125 V., 190-250 V., 60 cy. or 50 cy. Insulated secondary is constant 115.0 V. ± 1% from no-load to full-load of 17.4 amp. So, if you choose, use it as a 220:115 V. step-down. And slash $97.50 off the factory 1-input price!

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sociated with the service department for nine years, most recently as assistant service manager.

* * *

ELDON MANUFACTURING COMPANY of Los Angeles has acquired controlling interest in **UNGAR ELECTRIC TOOLS, INC.** Both companies will operate independently but under the presidency of Robert Silverstein . . . **HARRIS-INTERTYPE CORPORATION** of Cleveland has purchased **GATES RADIO COMPANY** of Quincy, Ill. The new acquisition will remain in Quincy with Parker S. Gates continuing as president. It is planned to operate the business on a decentralized basis with the present organization . . . **PERMACEL TAPE CORPORATION** has changed its name to **PERMACEL-LEPAGE'S INC.** to reflect the increasing diversity of its product line. Headquarters of the corporation are located in New Brunswick, N. J. with plant facilities in six other cities in the U. S. and Canada . . . A new manufacturers' representative firm, **WILLIAM LOGAN,** has been established at 1477 S. Mayfair, Daly City, Calif. The company will cover northern California and northern Nevada. Warehouse facilities are being provided.

* * *

INSTITUTE OF HIGH FIDELITY MANUFACTURERS, INC. has announced the appointment of subcommittee chairmen in connection with the Standards of Measurement for High Fidelity Equipment program now under way.

Daniel Von Recklinghausen of *Hermon Hosmer Scott, Inc.* heads the high-fidelity tuner group; Dick Shottenfeld of *Pilot Radio Corp.* is in charge of the amplifier subcommittee; Abe Cohen of *University Loudspeakers, Inc.* will preside over the speaker group; George Silber of *Rek-O-Kut Company* will handle turntables; Milton Thalberg, *Audiogersh Corp.* will act for the record changer group; and Walter Stanton of *Pickering & Company* will oversee the activities of the phonograph cartridge subcommittee.

The entire standards program is under the direction of Joseph N. Benjamin, *Pilot Radio Corp.,* a director of the Institute. —30—

Answer to Puzzle appearing on page 167.

T		V	A	C	U	U	M	T	U	B	E		S	G
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SATELLITE RECEIVER

Receive Radio Signals being transmitted by the U. S. Satellite—on approx. 108 MC. This Receiver is AM and Crystal Control on Six preset frequencies in the 108.3 to 110.3 MC range. Provides audio and band pass filter output of 90 & 150 cycles for aircraft instrument landing, for which it was originally used. Complete with Ten Tubes: 1/12AH7, 2/12SG7, 2/12SR7, 1/12SQ7, 3/717, 1/12A6. Crystals and Schematic. Voltage required: 12 or 24 VDC & 220 VDC 80 MA. Size: 13⅜" x 5" x 7". Also can be converted to FM Receiver 80 to 108 MC. Prices:
Used, Less Tubes & Crystals: $4.95.
New, Complete with Tubes & Crystals: $12.95.
Control Box—New: $2.00.
Cross Point Indicators, Used: $2.00.
Plugs for Receiver, Indicator, or Control Box $1.00 Each

6 VDC DYNAMOTORS:

640 VDC—280 MA—Reconditioned by G.E.....$12.95
420 VDC—280 MA—Reconditioned by G.E..... 9.95

12 VDC DYNAMOTORS:

		NEW:	USED:
625 VDC—225 MA	DM-35		$11.95
540 VDC—450 MA	DA-12	$14.95	11.95
425 VDC—163 MA	WE-377	12.95	9.95
225 VDC—100 MA	D-402	5.95	8.95
220 VDC—80 MA	DM-34		2.95
230 VDC—90 MA	PE-133	4.95	
150 VDC—100 MA	DM-310X		2.95
250 VDC—60 MA	DM-32-12V	4.95	
250 VDC—50 MA	DM-25	4.95	2.95

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Gasoline Engine GENERATOR

1000 Volts DC 350 MA & 14 VDC 25 Amp gasoline engine Generator. Engine 2.5 HP 4 cycle. Generator output 1000 VDC 350 MA & 14.6 VDC 25 Amp. Control Box has starting switch, ammeter, circuit breakers, reversing switch, etc. Can be used for transmitter standby and low voltage can be used for charging battery. Gov't. reconditioned, like new with spare parts and tools. Shipping Wt. 300 lbs. F.O.B. Ky.
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115 Volt 60 cycle Receiver for Airport monitoring. Frequency Range: 200-500 KC Five Tube, fixed tuned TRF Circuit by use of four Plug in coils. Unit fits standard 19" Rack Panel, 3½" deep. Complete with Tubes: 2/6SK7, 6SJ7, 6V6, & 5Y3GT and Four Plug in Coils to cover the Freq. Range. Also Instruction Book. NEW: $18.95

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Control Indicator with 25 Tubes, consisting of: 12/6SN7, 5/6SL7, 7/6V6, & 1/5CP1. All Controls on front panel, such as horizontal, vertical, sweep, intensity, centering, input and output circuits, etc. Voltage required: 2400 VDC 300 VDC & 6.3 V. Size: 24" L. x 20" D. x 10½" H. Complete with tubes and circuit diagram .....NEW: **$14.95**

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FM RECEIVER—30 TO 50 MC
Gov't. surplus, converted to receive any frequency in 15 MC spread. Continuous tuning & 10 preset push buttons. 10 tubes, speaker, squelch circuit, phone jacks, etc. Size: 11¼"x6¾"x 12½". Used, checked. Specify freq. spread.
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BC-603 FM RECEIVER—20-27.9 MC—Same as above: not converted. Prices: Used: $14.95; Excellent $19.95.
BC-683 FM RECEIVER—27-38.9 MC—Same as above: not converted.....Used: $24.95
BC-604 Trans. FM 20 to 27.9 MC—U: $14.95: N: $19.95
BC-924 Trans. FM 27 to 39.1 MC—U: 14.95: N: 19.95
BC-620 Trans.-Receiver FM 20 to 27.9 MC. Used: 14.95
BC-659 Trans.-Receiver FM 27.9-30.1 MC. Used.: 19.95
6 or 12 VDC Power Supply f/BC-620 or BC-659.U: 9.95
New: 12.95

I-208 FM SIGNAL GENERATOR

I-208 FM SIGNAL GENERATOR—Standard of Voltage Frequency and Frequency Deviation for the test alignment, calibration, sensitivity measurements of FM Receivers. Frequency Range 1.9 to 4.5 MC & 19 to 45 MC. Frequency Deviation can be adjusted 0 to 5 KC for 1.9 to 4.5 MC and 0 to 50 KC each side for the 19 to 45 MC Band. Stability .03 percent through use of crystal calibrator. Modulation Freq.: 150-400, 1000, 2500, & 5000 CPS. With Output Meter & Speaker: 115 Volt 60 cycle or 12 VDC input—Used.....$59.50

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Be careful before you answer. GENIAC® the first electrical brain construction kit is equipped to play tic-tac-toe, cipher and encipher codes, convert from binary to decimal, reason (in syllogisms) as well as add, subtract, multiply and divide. Specific problems in a variety of fields—actuarial, policy claim settlement, physics, etc., can be set up and solved with the components. Connections are solderless and are completely explained with templates in the manual. This covers 33 circuits and shows how new ones can be designed.

You will find building and using GENIACS® a wonderful experience; one kit user wrote us: "this kit has opened up a new world of thinking to me." You actually see how computing, problem solving, and game play (Tic-tac-toe, nim, etc.) can be analyzed with Boolean Algebra and the algebraic solutions transformed directly into circuit diagrams. You create from over 400 specially designed and manufactured components a machine that solves problems faster than you can express them.

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SEND for your GENIAC kit now. Only $19.95 with over four hundred components and parts; fully illustrated manual and wiring diagrams. We guarantee that if you do not want to keep GENIAC after one week you can return it for full refund. Add $1 west of the Miss. $21.95 outside U.S.A.

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A MUST FOR STEREO RECORDING

BULK ERASURE OF BOTH STEREO TRACKS

Erases recorded signals and noise from magnetic tape without rewinding. Spindle mounting of reel permits rapid coverage without missed spots. Noise level reduced below level of standard erase heads. Restores tape to like new condition or better. Reel size range 5", 7", 10½". May also be used for demagnetizing record—playback—erase heads.

Model HD-11 Price **$27.50**

TELEPHONE PICK-UP COIL

For transcribing telephone conversations with recorder or making messages audible on amplifier. May also be used as probe for locating sources of hum. More constant signal level than base mounted units. Suction-cup mounting on any telephone receiver. Supplied with 6ft" shielded cable, terminated with standard phone plug for recorder or amplifier.

Price **$7.95**

Model HP-61

MATCHING TRANSFORMER

A precision transformer developed to enable the audiophile to modify, enlarge, redesign, or rearrange his speaker systems. Permits use of additional speakers of different impedance ratings with present amplifier, or crossover networks, without impedance mismatch. Delivers equal, or 3 db. adjustable power, to all speakers. Power 50 watts, 100 watts peak. Frequency response 15 to 30,000 cycles. Matching range: any combination of 1 to 3 speakers of 16, 8, 4 Ω.

Model HM-80 Price **$21.75**

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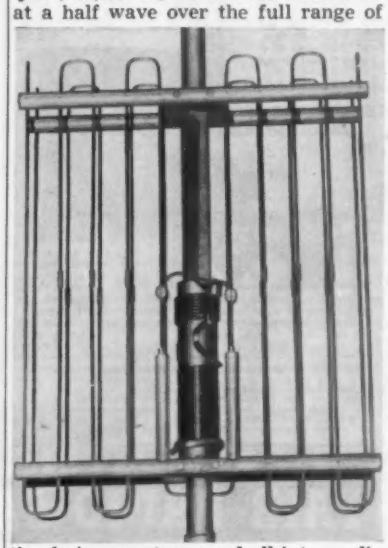
MICROTRAN COMPANY Inc.
Valley Stream, L. I., N. Y.

NEW ANTENNA FOR HAMS

Freeman Company of Yankton, S. D., is in production on a new short-wave antenna which is just 27" high by 22" wide that is claimed to do the work of a standard antenna 32 feet wide.

Designed and developed by Stan Byquist, WØMBH, the antenna resonates at a half wave over the full range of



the design spectrum and all intermediate frequencies. It accepts r.f. over a band 50 kc. wide each side of the resonant frequency. Resonance is easily accomplished with the adjustment features provided.

Tradenamed "The Little Giant," the compact and lightweight construction permits the antenna to be mounted on a standard TV roof mount. A standard 52-ohm coax fitting is provided in the antenna's base for feedline connection and the line is substantially flat at the resonant frequency.

The manufacturer will supply full details on the various models available in standard and custom versions.

FM ANTENNA KIT

Telco Electronics Mfg. Co., 400 S. Wyman St., Rockford, Ill., is now offering a new FM antenna kit which is especially easy to install.

The antenna itself is of the turnstile design and features a self-supporting base. No alignment or orientation is necessary and the electrical portion is engineered to give longer trouble-free life.

The kit comes ready for installation with ⅜" aluminum elements. A mast, mast base, and 60 feet of transmission line allow the unit to be mounted to meet the user's requirements. All necessary mounting hardware is included with the kit. The kit is catalogued as No. A-124. The company will supply additional details on request.

WHIP ANTENNA FOR MOBILES

Mark Products Company, 6412 W. Lincoln Ave., Morton Grove, Ill. is now in production on a new line of "Heliwhip" antennas for mobile operations in the ham bands from 3 to 30 mc.

The design consists of a variable pitch helical winding on a Fiberglas rod with the turns so proportioned as to result in an essentially linear current distribution on the radiator. The v.s.w.r. on 50-ohm line runs around 1.3:1 on frequency with the total bandwidth for a 2:1 v.s.w.r. of 100 kc. at 29 mc.; 500 kc. at 21.2 mc.; 250 kc. at 14.2 mc.; 100 kc. at 7.2 mc.; and 60 kc. at 3.8 mc.

The units are 4 feet long for 10 and 15 meters and 6 feet long for 20, 40, and 80 meters. Custom units for all frequencies in the range 3 mc. through 50 mc. are available on special order. Write the company for a data sheet.

"WUN/ROD" ANTENNA

Snyder Mfg. Co. of Philadelphia, Pa. has recently introduced a single-staff indoor antenna for TV receivers.

The new antenna, known as the "Wun/Rod Directronic 9-D", is designed to be mounted quickly and safely on the back of any set. It can be used for black-and-white, color, u.h.f., v.h.f., and FM reception in any metropolitan area.

The most unusual feature of the new design is its tuned vertical polarization which permits the extension of the four-section single staff to the height which permits best reception. In addition to extension of the single mast, the latter can also be rotated for adjustment to bring clearest reception for each channel.

ANTENNAS AND ACCESSORIES

JFD Electronics Corp., 6101 Sixteenth Ave., Brooklyn 4, N. Y. is now offering two new sales promotion brochures for service dealers.

One 6-page, 4-color brochure describes comprehensively and illustrates in giant size every major indoor an-

tenna made by the company. All models are listed in full detail, from the deluxe "Magic Genie" to the "Venus" table-top rabbit ear model. The literature was designed to double as a streamer or ready reference source.

The second publication is a 2-color gatefold catalogue which describes the firm's recently expanded line of TV accessories. Included are outdoor and indoor set couplers, outdoor-indoor antenna couplers, wavetraps, baluns, impedance matching transformers, antenna isolators, attenuators and switches, etc.

Either or both of these brochures may be obtained without charge on request.

TELCO ANTENNA CATALOGUE

Telco Electronics Mfg. Co., 400 S. Wyman St., Rockford, Ill. has published a 24-page illustrated catalogue which lists 92 different antenna models for v.h.f. and u.h.f., color, and black-and-white TV, and 10 do-it-yourself antenna kits.

Catalogue A-58 lists and pictures conicals, in-lines, dipoles, bow-ties, corner reflectors, and yagis. Copies of this publication are available without charge from the manufacturer.

ANTENNA DISPLAY CARTON

In order to stimulate the sale of its new "Piggy Back" indoor television antennas, *Clear Beam Antenna Corporation*, 21341 Roscoe Blvd., Canoga Park, Calif. has issued a new point-of-sale display carton for dealers and distributors.

When set up, the display contains an antenna mounted as it would actually be installed on the rear of the TV set.

Since the display doubles as a master container, all orders are being shipped already packed in the display.

OUTDOOR SET COUPLER

JFD Electronics Corp., 6101 Sixteenth Ave., Brooklyn 4, N. Y. is now in production on a new line of outdoor receiver couplers.

The new units install on the mast by means of a sturdy U-bolt assembly. This enables the service technician to run all necessary lead-ins along the exterior of the house to the rooms in which TV sets are installed. Messy drilling through interior walls or floors is eliminated.

(*Continued on page* 172)

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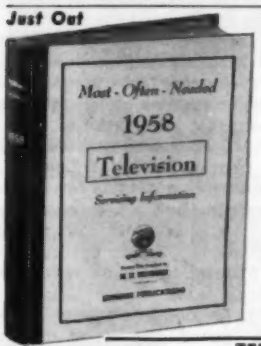

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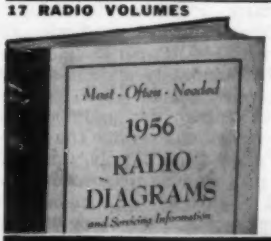

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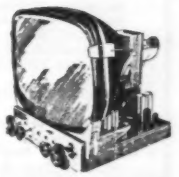

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Housings for these new couplers are molded of water-resistant and high-strength butyrate. Three models are currently available: Model AC40 for coupling two 300-ohm sets, Model AC60 for handling three sets, and the Model AC70 for coupling four receivers.

Descriptive literature on these new couplers is available from the firm.

SELF-SUPPORTING TOWER

Spaulding Products Company, 550 W. Barner St., Frankfort, Ind., has developed a new high-strength, self-supporting antenna tower which is available in heights up to 125 feet.

This inexpensive tower utilizes the same bridge-type construction as the firm's well-known "X Series." This unit is of all riveted construction, completely galvanized, and has beaded-channel legs to give high compressive strength.

Open-type construction has been utilized to facilitate corrosion control, especially in salt water areas. The tower may be erected in a short time without the use of elaborate equipment.

CONDUCTOR LEAD PATENT

Fretco Incorporated, 406 N. Craig St., Pittsburgh 13, Pa. has been granted a U. S. patent for the processes involved in the manufacture of its multiple-strand conductor leads. The end products are integral parts of the company's "Fretaray" antennas and open-wire transmission lines.

The product is now covered by U. S. Patent No. 2081070, granted October 22, 1957. Ten basic claims were allowed.

COAXIAL ADAPTERS

Antenna Specialists Company, 12435 Euclid Ave., Cleveland 6, Ohio has developed three new coaxial adapters which are designed to permit service technicians to install an antenna speedily from the outside of a car.

According to the company, it is no longer necessary to mount an antenna by tightening nuts from inside the car body. The Model ASP-160 adapter eliminates the need to split the lead-in cable and attach it to terminal screws by permitting an installer to use a coaxial fitting on the end of the lead. With Model ASP-161, a new coaxial outside mount that includes the ASP-160 in its assembly, a cable can be snaked through holes in the inner shell of the car body and attached to an antenna prior to mounting. The Model ASP-162, an outside right-angle adapter, was designed expressly for use where cable must be snaked through between the inner and outer shell of the car body. —30—

"SERVICING TV SYNC SYSTEMS" by Jesse Dines. Published by *Howard W. Sams & Co., Inc.,* Indianapolis 5, Ind. 311 pages. Price $3.95. Paper bound.

This text covers the operation and troubleshooting of sweep and sync circuits of the type that appear in both the older and present-day television receivers.

The first four chapters of this book deal with the circuit fundamentals while the last two chapters cover troubleshooting procedures and service hints. The variations in sync systems and circuits are covered in separate chapters for most comprehensive coverage.

The text material is lavishly illustrated by schematics, graphs, scope patterns, and photographs. The treatment is straightforward and concise. Technicians should find this material helpful in speeding servicing procedures in the shop.

* * *

"RECEIVING AERIAL SYSTEMS" by I. A. Davidson. Published by *Philosophical Library Inc.,* New York, 148 pages. Price $4.75.

This is a specialized text for those concerned with designing and installing antenna systems for the reception of broadcast and television signals, particularly in domestic applications.

The author, who is associated with the British firm of *Belling & Lee Ltd.,* naturally discusses antennas for reception of signals in the British frequency allocation bands but the principles could be equally applied to coverage of the AM, FM, and television spectrum in the United States.

The text is divided into twelve chapters which cover the fundamental concepts, directional characteristics, half-wave dipoles, antennas for single-channel reception, the choice of antenna, r.f. cables and accessories, the mechanical design of antennas, installation procedures, the measurement of antenna characteristics, etc.

* * *

"REPAIRING HI-FI SYSTEMS" by David Fidelman. Published by *John F. Rider Publisher, Inc.,* New York. 197 pages. Price $3.90. Paper bound.

Since the popularity of high-fidelity sound reproduction is so widespread and since the demand for qualified technicians to install and service the equipment still exceeds the supply, this book has been prepared as a handbook for radio and television technicians who would like to expand the scope of their activities to include audio servicing.

The text is divided into ten chapters with the introductory material covering the similarities and differences in

the two service jobs. The balance of the book deals with specific components of a high-fidelity system, covers the test equipment required in professional servicing, the construction and installation of equipment, and how to perform a limited number of service procedures without instruments.

In addition to the professional technician, much of the material in this well-written text would be of interest to the advanced audiophile whose technical "know-how" gives him confidence in his ability to handle some of the more minor adjustments himself.

* * *

"HIGH FIDELITY SIMPLIFIED" by Harold Weiler. Published by *John F. Rider Publishers, Inc.*, New York. 197 pages. Price $2.50. Paper bound. Third Edition.

This is a new and up-to-date version of a book which originally appeared in 1952. Written expressly for the music lover who may or may not have a technical background, the text spells out "working rules" for assembling home sound systems to meet specific program material needs.

In the first chapter the author outlines the components which comprise a high-fidelity music system and explains briefly something of their function. Subsequent chapters enlarge the theme and provide specific information on speakers, enclosures, amplifiers, record players, tuners, and tape recorders.

The fact that many sincere music lovers live miles from cities where audio salons and live programs are available is recognized by the author and he has taken pains to explain how persons in more isolated sections of the country can still have the music they want.

Older equipment discussed and pictured in the earlier editions of this volume have been replaced by current models. —30—

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OZ4	.80	5BC8	1.10	12AX7	.79	2021	.65
1A7	1.00	6BZ7	1.25	12BA6	.65	3023	5.00
1B3	.78	6C4	.49	12BA7	.99	717A	5/$1
1R5	.78	6C5	.69	12BD6	.59	4-125	29.00
1S4	.78	6C8G	.80	12BE6	.59	4-250	35.00
1T4	.78	6CD6	1.49	12BF6	.59	4E27	7.00
1U4	.68	6H6	.59	12BH7	.99	4PR60	29.50
1U5	.89	6J5	.59	12BY7	1.00	4X150	19.00
1X2A	.68	6J6	.59	12BZ7	.99	4X250	35.00
3Q4	.68	6K6	.59	12CU6	1.45	4X500	38.00
3Q5	.86	6K7	.79	12SA7	.69	5BP1	1.98
3S4	.68	6L6	1.19	12SQ7	.89	5BP4	1.98
3V4	.99	6S4	.89	12SH7	.89	5T	4.00
5B4	1.25	6S8	.99	12SJ7	.75	100T	7.00
5U4	.59	6SA7	.69	12SK7	.75	250T	20.00
5V4	.89	6SB7	1.19	12SQ7	.69	388A	1.00
5Y3	.59	6SC7	.89	19BG6	2.15	418A	14.00
6AB4	.59	6SG7	.79	19T8	1.15	450T	43.00
6AC7	.79	6SH7	.69	25BQ6	1.39	807	1.10
6AG7	.89	6SJ7	.69	25L6	.72	808	1.00
6AH6	.99	6SK7	.72	25W4	.77	809	3.00
6AK5	.69	6SL7	.89	25Z5	.72	811	10.00
6AL5	.59	6SN7	2/$1	25Z6	.75	811	3.00
6AQ5	.66	6SQ7	.74	EL34	3.49	813	3.00
6AT6	3.04	6SR7	.79	EL37	2.49	833	8.50
6AT6	.49	6T8	.98	35L6	.59	814	2.45
6AU4	1.29	6U8	.98	35W4	.52	815	2.50
6AU5	1.19	6V6	1.39	35Y4	.69	829B	8.00
6AU6	.59	6W4	.79	35Z5	.57	832A	6.00
6AX4	.79	6W6	.89	50A5	.69	866A	1.60
6BA6	.59	6X4	.39	50B5	.69	6146	4.00
6BA7	1.00	6X5	.49	50C5	.69	5679	1.20
6BD6	.69	6Y6	.89	50L6	.69	5881	2.70
6BE6	.59	7N7	.89	KT66	3.29	6550	3.90
6BG6	1.50	12AL5	.59	7S	.89	5842	11.00
6BH6	.79	12AQ5	.79	8D3	.79	6854	1.00

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1200 Ft.—7" Reel **$1.45** *Lots of 3*

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Highest quality controlled plastic base tape made by new Erin process. Precision coated & Slit. Gtd. Constant output. Splice Free. Freq. 7½ IPS 40-15KC Oxide Wnd In.

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With inbuilt Network Ticonal Alnico 5 Plus Magnet, 4 to 8 ohms V.C.

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12" *3-WAY*, 20 Watt/35-18,000 Cycles. MODEL F12H3X. Wgt. 10 lbs..... $28

12" COAX. 20 Watt/35-18,000 Cys.. $22

6"/25 Watt Midrange 300-6000 Cys.. $24

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NEW "TEKSEL" SELENIUM BRIDGE RECTIFIERS. ONE YEAR GTD!

FULL WAVE BRIDGE • *WRITE for CATALOG*

CURR.	18VAC	36VAC	72VAC	144VAC
CONT.	14VDC	28VDC	56VDC	112VDC
1AMP	$ 1.50	$ 2.30	$ 5.30	$ 13.00
2AMP	2.35	3.35	6.45	16.00
3AMP	3.00	4.15	9.60	19.00
5AMP	4.45	6.85	19.30	35.00
10AMP	6.50	12.60	27.90	49.00
12AMP	8.10	15.90	32.75	57.35
24AMP	16.15	32.40	63.60	144.50

BAT. CHARGER STACKS. FAN COOLED REPLACEMENT OR CONVERSION. *Discounts to Qty. Users*

CR20R	CR32D	BR18R	BR18C	BN18R
10VAC/CT	18VAC/CT—	INPUT—18VAC		
6VDC/100A	6VDC/100A &	12VDC/50AMP	50A/40A	
$14	$20	$24	$26	$20

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115VAC Inpt Transformer & Full Wave Bridge Rectifier for 12VDC@2AMPS, or PECTRAN KIT RT1K..... $4.50
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FEBRUARY 1958

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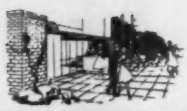
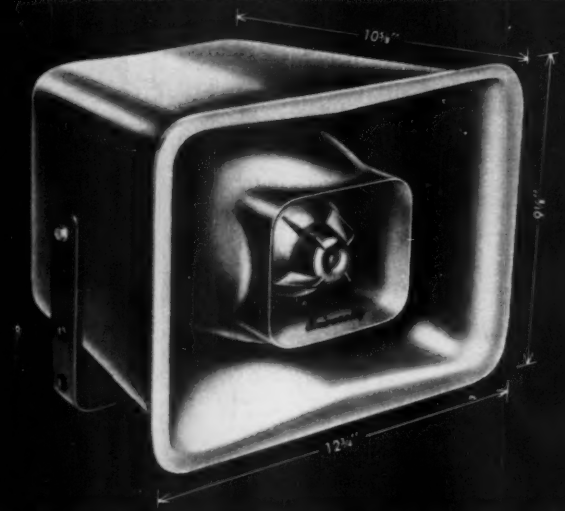
Neat, trim, unobtrusive, the MLC is a superb little performer too. Delivers clean, sweet music and voice reinforcement that overcomes noise and dead spots.

SOUND AND AMUSEMENT TRUCKS
The versatile, dependable MLC efficiently handles all types of program material without harsh, annoying blare prohibited by many town ordinances.



PATIOS, SWIMMING POOLS, LAWNS
Here's weatherproof high fidelity that is also low in price. With the MLC, you can economically extend a music system outdoors and retain hi-fi quality.

TO ADD HI-FI TO P.A. SYSTEMS
In paging applications, the MLC penetrates high noise levels . . . its wide frequency range adds deep richness to music reproduction. Here's double duty, double value!



MODEL

NEW...UNIVERSITY DUAL-RANGE MLC

Weatherproof Super-Compact Speaker System for Voice and Music

Now...real high fidelity never before available in a rugged, small size, weatherproof speaker system. Unique wide-angle, dual folded horn design with separate low and high frequency drivers. Dependable, easy to install, low in cost, the MLC offers these outstanding features:

BETTER LOWS: Balanced "compression" folded horn, starting with 6" throat and energized by top quality woofer driver provides *more* lows than other designs.

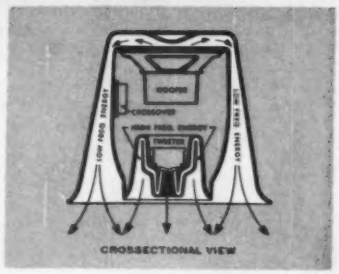
BETTER HIGHS: Driver unit tweeter with wide angle horn transmits more highs with greater uniformity . . . high frequency response that you can hear!

BETTER EFFICIENCY: Dual range theater type system permits uncompromising design of the woofer and tweeter sections for greatest efficiency. Penetrates noise with remarkable fidelity and intelligibility.

LESS DISTORTION: *Separate* low and high frequency driver systems reduce intermodulation and acoustic phase distortion found in other systems which use two different horns on a single diaphragm.

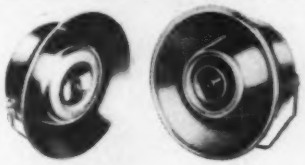
MORE DEPENDABLE: Experienced mechanical engineering and careful electrical design meet the challenge of diversified application and environmental hazards. Rugged and conservatively rated—you can *rely* on the MLC.

SPECIFICATIONS: Power Capacity, 15 watts; Frequency Response, 150-15,000 cps; Impedance, 8 ohms; Dispersion, 120°; Sound Pressure Level, 117 db taken at 4 ft., 750-1250 cps with 1 cps sweep; Dimensions, Bell Mouth 12¾" W x 9⅛" H, Overall Depth 10⅝"; Shipping Weight, 10 lbs.; $54.50 List.



CROSSECTIONAL VIEW

FOR HEAVY DUTY APPLICATION...



MODEL BLC MODEL WLC

MODEL BLC employs same design principles as the MLC except for heavy duty 8" woofer with uniform response from 70 cps, exclusive "reciprocating flare" wide-angle tweeter and has 25 watt power capacity. Exceptionally shallow depth, only 9", ideal for close quarters. **$86.00 List.**

MODEL WLC, largest of the series, has 30 watt power capacity, 12" super-efficient woofer with response from 50 cycles, heavy duty radial tweeter . . . and a decade of successful performance in concert halls, rinks, auditoriums, stadiums and outdoor theaters throughout the world. **$250.00 List.**

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